COMPUTER PROGRAMS FIELD AND LAB
FOR CALIBRATION OF FALLING WEIGHT DEFLECTOMETERS

for

Wyoming Department of Transportation

THE UNIVERSITY OF TEXAS
AT EL PASO

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ABSTRACT

Falling Weight Deflectometers (FWD) are presently being used by many highway agencies. The primary function of FWD devices is to measure a deflection basin due to a load imparted to the pavement. Deflection basins measured in the field are used in backcalculating modulus profiles of pavement sections. As such, it is critical to determine the deflection basins in the field with accuracy. Velocity transducers (also called geophones) or other deflection sensors are used to determine the deflections, and load cells are utilized to measure applied loads.

It has become increasingly important in recent years to be able to evaluate the performance of the deflection and load sensors of the Falling Weight Deflectometer devices. It has been shown that a small error in the deflection measured in the field may yield significantly erroneous modulus values. As such, a reliable method for evaluating the accuracy of the sensors used for determining these deflections is necessary.

This report contains users manual for two computer programs called "FIELD" and "LAB" used in reference calibration process developed at UTEP. The two programs have been developed to control the acquisition and digitization of sensors' signals, to reduce the collected data, and to present the data. The programs are coded for an IBM-PC Compatible equipment with DT 2825 Analog-to-Digital board manufactured by Data Translation™, Inc. The programs are written in FORTRAN and compiled with MICROSOFT™ FORTRAN (5.1) Compiler.

The computer program FIELD is capable of: 1) controlling the acquisition and retrieval of the analog data captured by the sensors; 2) reducing the collected data; and 3) developing a summary file from the results. The program provides software-controlled initialization and identification of the A/D board and facilitates the collection of data using Direct Memory Access (DMA). The acquired data are stored in a file for further processing.

The program LAB can be used to reprocess previously collected data. In addition, the collected data and reduced results can be graphically inspected.
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1. INTRODUCTION

Programs FIELD and LAB are interactive programs coded for the purpose of calibrating Falling Weight Deflectometer (FWD) devices. The programs were developed to control the acquisition, digitization and retrieval of analog data produced by the calibration sensors, to reduce the collected data and to present the data. The programs provide software-controlled initialization and identification of the analog-to-digital conversion (A/D) board and facilitates the collection of data using Direct Memory Access (DMA).

These programs are coded for an IBM compatible computer equipped with a DT 2825 A/D board, manufactured by Data Translation, Inc. The program is written in FORTRAN and compiled with Microsoft Version 5.1 FORTRAN compiler. In addition, two graphics libraries are also utilized.

2. INITIAL PREPARATION

Software, hardware and mechanical equipment needed:

1) IBM PC or Compatible
2) Dos 3.3 or later versions
3) Microsoft FORTRAN Compiler (Version 5.1)
4) ATLAB Software by Data Translation, Inc.
5) PLOTIT Graphics Software
6) Floating point math coprocessor (80387)
7) Signal Conditioning unit (see Appendix F)
8) Three well-calibrated geophones (see Appendix F)
9) Three load cells (see Appendix F)
10) Triggering mechanism (the Proxi-switch) (see Appendix F)
11) Proper connectors for geophones and load cells.

To operate the system:

1) Install the data acquisition board in the computer
2) Connect the data acquisition board to the back panel of the signal conditioning unit using the 50-pin ribbon cable.
3) Connect the three geophones to the front panel of the signal conditioning unit. Make sure that proper geophone is connected to proper channel of signal conditioning unit (e.g., Geophone 1 should be connected to the connector labeled Geophone 1, etc.).

4) The three cables with BNC connectors on both sides are used for connecting the load cells to the signal conditioning unit. Once again, make sure that proper load cell is connected to proper channel. If the load cells are connected properly, both the yellow and red lights directly above the connector will be off. An illuminating yellow light indicated that there is a short in the system. Probably the cable or one of the connectors has gone bad. If the red light continuously stays on, it means that the system is open. If the red light blinks during testing, the load cell is being overloaded or one of the connections is loose.

5) Connect the prezi-switch to the appropriate connector on the front panel. The switch itself should be placed on the FWD device.

6) Turn the signal conditioning unit on using the switch on the back panel.

7) Carefully position the load plate under the FWD loading pad. This step is needed only if a load calibration has to be carried out. Make sure that all the load cell cables are away from the moving parts. Do not forget to cover the load cells with the cover plate.

8) Position the geophones provided by the calibration system close to the sensors of the FWD.

9) Activate the software as described below.

**Computer programs, files and libraries needed:**

1) ATLAB.LIB developed by Data Translation, Inc.
2) DIG.LIB and VIG.LIB graphics library
3) Microsoft FORTRAN (Version 5.1) Libraries
4) ATLDEFS.FOR (the file has information about the board and the board is initialized and identified by the definitions available in this file.)
5) ATLERRS.FOR (the errors detected by the board are displayed on the screen with the help of this file.)
6) FIELD.FOR and/or LAB.FOR
7) REDUCE.OBJ (the object file that contains the reduction subroutines)
8) CALIBRAT.DFT (contains the nature and the number of drops to be used in the calibration process and example is given in Appendix A)
9) COMPILE.BAT (this file is used to compile the program and is included in Appendix B).
We recommend that all these items be located in a directory called "CALIBRAT.SRC". For compiling the program, the "COMPILE FILE" or "COMPILE LAB" command should be typed at the DOS prompt from the directory "CALIBRAT.SRC". Please note that the programs will not compile properly if all these files are not available.

We also recommend that a new directory called "CALIBRAT.BIN" be created. This directory should be used for day-to-day operation of calibration. Three files: FIELD.EXE, LAB.EXE, and CALIBRAT.DFT should be copied to this directory. For ease of use, directory "CALIBRAT.BIN" should be added to the Path in the AUTOEXEC.BAT file. Consult your DOS Manuals, for more information.

**Program FIELD may not execute if:**

1) File CALIBRAT.DFT is not available.
   Generate the file as instructed in Appendix A and repeat the execution.

2) Data acquisition board is not properly installed.
   Make sure that the data acquisition board is installed properly in the computer.
   Make sure that the data acquisition driver is included in the CONFIG.SYS file.

3) Geophone 1 is not connected to the filter box.
   Connect Geophone 1 to the box and repeat tests, if instructed by the software.

4) The proxsi-switch is not connected properly.
   Make sure that the switch is properly connected to the filter box.
   The proxsi-switch may be too close to the ground. Move the proxsi-switch up, if instructed by the software.

**3a. EXECUTION OF PROGRAM FIELD**

The program can be started by typing "FIELD" at the DOS prompt. The execution of the program is described in the following steps:

**STEP 1: Program Initiation**

This step is self-explanatory.
TO STOP EXECUTION AT ANY TIME, PLEASE ENTER -99

GEOPHONE 1 SHOULD BE CONNECTED TO SYSTEM OTHERWISE, THE SYSTEM WOULD NOT FUNCTION

PRESS RETURN TO CONTINUE

STEP 2: Reporting the status of the system

In this step, the set-up for each channel of the data acquisition board is reported. The computer screen illustrates the following.

THE DEFAULT VALUES ARE:

TOTAL NUMBER OF CHANNELS = 8
NUMBER OF GEOPHONES = 3
NUMBER OF LOAD CELLS = 3
NUMBER OF OTHER DEVICES = 2

CHANNEL DESCRIPTION

<table>
<thead>
<tr>
<th>CHANNEL</th>
<th>GAIN</th>
<th>ID</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>G1</td>
<td>GEO 1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>G2</td>
<td>GEO 2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>G3</td>
<td>GEO 3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>L1</td>
<td>LCEL 1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>L2</td>
<td>LCEL 2</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>L3</td>
<td>LCEL 3</td>
</tr>
</tbody>
</table>

TIME SPAN FOR COLLECTING DATA (Seconds) = .1250
DATA POINTS PER CHANNEL = 256
ANY CHANGES TO DEFAULT VALUES (y/n)?
With the data acquisition board provided, the gain of each channel can be selected individually. The gain is typically changed if the voltage output from a sensor is significantly smaller than ±10 V. Practically speaking, all the sensors in the calibration device provide adequate voltage. Therefore, the adjustment of the gain is not necessary. See Appendix C for ways to change the gain.

The ID and name are used to identify the geophones provided with the calibration system. The program utilizes this information to obtain the calibration parameters internally. Please do not change the default ID’s and names if you utilize the system just for calibration purposes. If the names or ID’s are changed, the program will ask for the new calibration parameters. See Appendix C for more information.

An adequate time window for collecting FWD data is 125 msec. However, if longer or shorter time spans are needed, this value can be easily changed as shown in Appendix C. The shortest and longest period depends on the limitations of the data acquisition board. Please familiarize yourself with these limitations before changing the time period. The software, in some instances, may warn you of potential problems.

The data points per channel is set as 256. This is a good compromise for obtaining good resolutions in both the time and frequency domain analyses and data presentation. This value can be easily changed. However, the new value has to be a power of 2, such as 128, 512, 1024, etc. See Appendix C for means of changing this value.

To change any of the parameters mentioned above, you need to respond “YES” (or “Y”) to the question asked at the end of this step. In this case refer to Appendix C for detailed instruction. However, the answer to this question is typically “NO” (or “N”).

STEP 3: Creating data files

In this step, the device and the sensors to be calibrated are identified. The following will appear on the screen.

NOW BOARD IS READY TO COLLECT THE DATA
INPUT THE IDENTIFICATION NAME

Any arbitrary name containing numbers or letters (e.g. F123, Test, etc.) can be utilized here. Some agencies with more than one FWD use the serial number of the device. The response has to have exactly four letters. If more or less letters are used,
the program will either truncate the name to four letters or it will warn you and ask you to modify the name.

The program will automatically "date-stamp" the filename; that is, it will add a four-digit number to the end of the name you selected to develop an appropriate filename. The first two digits of the added number corresponds to the year, and the last two digits corresponds to the month of calibration. For example, if the Identification Name" is typed in October, 1993 as "TEST", the filename used will be "TEST9310". Notice that 93 corresponds to the year and 10 corresponds to the month when the calibration was performed.

Several files with the same filename but different extensions are typically generated. These files include: 1) individual files that contain the raw voltages measured with the three load cells and the three geophones; 2) a summary file containing the loads and deflections measured with the calibration system for different drops. These files are described in more detail later on.

To develop the summary data file, the following two questions should be answered:

**First FWD Sensor (Geophone or Seismometer) to be Calibrated?**

**Second FWD Sensor to be Calibrated?**

The responses to these questions should be two one-digit numbers. As soon as these questions are answered, the computer will generate an ASCII data file. The filename was established above. The extension will be in the form "Sn.n", where "S" signifies that the file is a summary file and n, and n, are the two one-digit numbers obtained from the above questions. As an example, if Sensors 1 and 3 are being calibrated, the summary file will have an extension of "S15" and the entire filename will be "TEST9310.S15". It should be mentioned that the summary file will overwrite all older versions of the same file. Therefore, you should make sure that the older versions of the summary files are backed up before executing the program. Typical contents of a summary file are described in Appendix D.

The program will also attempt to create a data file with the filename established above but with a file extension "001"(e.g. "TEST9310.001"). This file will contain the raw voltage output from different calibration load cells and/or calibration geophone. The extension acts as a counter and for each drop height and each repeat a new file will be created. If the SHRP calibration protocol is followed for calibration of each sets of sensors, twenty files will be generated.
If this file does not exist, the program will proceed to Step 4. If the file exists, the following messages will appear:

FILE EXISTS...
FIND NEXT AVAILABLE EXTENSION? (Y/N)

If the answer is no, then the program will erase the old version of the file and rewrite the current information in it. If the answer is yes, then the software will check for the next available extension. For example, if in a previous session in that month files "TEST9310.001" through "TEST9310.015" were generated, the current information will be written in a data file "TEST9310.016". Typically, these files can be discarded, unless they are needed for a more thorough analysis of the data or for research purposes.

Step 4: Acquiring and Reducing Loads and Deflections

In the next step, the following information will appear:

DROP HEIGHT 1 REPEAT 1
HIT RETURN TO BEGIN ACQUISITION.

The first line appears as a reminder to the operator. The drop height counter varies from 1 to 4, and the repeat counter varies between 1 to 5. The numbers are read from data file "CALIBRAT.DFT". See Appendix A for more information with regards to CALIBRAT.DFT.

The "RETURN" button should be pressed to activate the data acquisition board. It is recommended that the operator of the FWD and the person conducting the calibration coordinate. The "RETURN" button should be pressed at about the same time that the FWD load is being released. Ignoring to do so may result in a timeout error. The FWD weights should be in the raised position before the "RETURN" button is pressed.

The next comment will be:

PLEASE WAIT WHILE DATA IS COLLECTED.....

This message suggests that the system has successfully collected the data and is in the process of reducing the data.

An alternative message may appear. This message is:

MOVE THE TRIGGER PROXI-SWITCH UP SLIGHTLY THEN REPEAT TEST ALSO MAKE SURE THAT GEOPHONE 1 IS SECURELY CONNECTED TO FILTER BOX.
This message signifies that the response from Geophone 1 of the calibration system is failing the quality control tests built in the software. The reasons for failing the quality control tests are several:

1) The proxi-switch is too close to the impact plate.
   To remedy this problem, move the proxi-switch upwards in 1-in. increments and repeat the process until the error message disappears.

2) The "RETURN" button was pressed too late.
   To remedy this problem, try to coordinate better with the FWD operator and repeat the test.

3) Geophone 1 of calibration system has problems.
   Please give us a call for instructions.

4) The filter box is malfunctioning.
   Please call us for instructions.

If the system is functioning properly, the following will appear next:

```
EXT   HT/RPT  LOAD   PEAK   PEAK TO PEAK
      GEO1  GEO2  GEO3   GEO1  GEO2  GEO3
001   1  1      90000  12.00 12.00 12.00 12.30 12.30 12.30
```

**SAVE THIS DATA? (Y/N)/ (TO TERMINATE PROGRAM)**

Different columns provide the following information:

- **EXT** The extension of the file that will contain the raw voltages from this drop height. As an example, the file "TEST9310.001" will contain the information provided above.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HT</td>
<td>The FWD drop height used.</td>
</tr>
<tr>
<td>RPT</td>
<td>The repeat number corresponding to the drop height.</td>
</tr>
<tr>
<td>LOAD</td>
<td>The magnitude of load measured with the calibration loading system.</td>
</tr>
<tr>
<td>PEAK</td>
<td>The peak deflections measured with the calibration system. Peak deflection is defined as the difference between the deflection at time zero to the maximum deflection measured. GEO1, GEO2, and GEO3 refer to the three geophones used by the calibration system.</td>
</tr>
<tr>
<td>PEAK to PEAK</td>
<td>The peak-to-peak deflections measured with the calibration system. This refers to the difference between the maximum rebound of the pavement and the maximum deflection of the pavement.</td>
</tr>
</tbody>
</table>

The response to the question can be YES (or Y), NO (or N) or - (negative sign).

For a YES response, the software will write the results in an identical format in the summary file (for our example file TEST9310.S15). In addition it will generate the raw voltage data file (in our example TEST9310.001). The execution will then be transferred to the beginning of Step 4, so that data for other repeats or other drop heights can be collected and processed. If all the drop heights and repeats requested in file CALIBRAT.DFT are exhausted, the execution of the software will be discontinued.

For a NO response, the load and deflections currently obtained will be discarded and Step 4 for the same drop height and repeat number will be repeated.

For a "-" response, the execution will be terminated instantly.

Upon successful completion of the calibration process, the following message will appear:

```
... Program terminated.
```
3b. EXECUTION OF PROGRAM LAB

The program can be started by typing "LAB" at the DOS prompt. The execution of the program is described in the following steps:

STEP 1: Program Initiation

This step contains a greeting message and a question.

TO STOP EXECUTION AT ANY TIME, PLEASE ENTER -99

PLEASE CHOOSE ONE OPTION

<T> REDUCE AND TRANSLATE DATA
<R> ONLY REDUCE DATA

If Option "T" is selected, the software will reduce and translate any data file saved with program FIELD. An example of these files is TEST9310.001 (see Section 3.a). These files are written in binary format for speed of operation and for conserving disk space.

Reducing refers to reading the raw voltage data from a file and reprocessing the data into deflections and load. The subroutine used for this purpose is identical to that used in program "FIELD". Naturally, as shown later, the output is also very similar.

Translating refers to reading the raw voltage data from binary files and writing the raw data as well as reprocessed data (i.e. actual deflection and load time-histories) in an ASCII format. In this manner, the raw or reduced data can be easily utilized in any spreadsheet program.

If Option "R" is selected, the program will only "reduce" the data and will not "translate" it.
STEP 2: Preparation for data files

In this step, the files to be processed are identified. The following will appear on the screen.

INPUT THE IDENTIFICATION NAME

The four-letter name assigned to the files during the execution of program FIELD should be input here. See Step 3 in the previous section for more detail. As an example, "TEST" should be input, if we are hypothetically reprocessing the data we collected with program FIELD.

INPUT DATE STAMP

The date stamp attached to the data files during the execution of program FIELD should be input here. Once again, see Step 3 in the previous section for more detail. As an example, for the example followed in the previous section, the date stamp would be "9310".

Once again, to establish a summary file, the following two questions should be answered.

FIRST FWD SENSOR (GEPHONE OR SEISMOmeter) TO BE CALIBRATED?

SECOND FWD SENSOR TO BE CALIBRATED?

A summary file very similar to that obtained during the execution of program FIELD will be generated. The summary file will be the same as the data files to be reprocessed (e.g., "TEST9310"). However, the extension will be "Rn,Rn", where "R" signifies that the file is a reprocessed summary file and n, and n, are the two one-digit numbers obtained from above questions. As an example, if Sensors 1 and 5 are being calibrated, the summary file will have an extension of "R15" and the entire filename will be "TEST9310.R15".

STEP 3: Reprocessing of Data

In this step, a specific file to be processed is identified. The following will appear on the screen.

ENTER THE FILE EXTENSION
The extension of a specific file to be reduced is input at this time. This extension should be a three-digit number as described above.

As soon as a valid extension is input, the reprocessing of the data will be carried out. The final outcome will be similar to:

```
<table>
<thead>
<tr>
<th>EXT</th>
<th>HITRPT</th>
<th>LOAD</th>
<th>PEAK</th>
<th>PEAK TO PEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GEO1</td>
<td>GEO2</td>
</tr>
<tr>
<td>----</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9000</td>
<td>12.00</td>
</tr>
</tbody>
</table>
```

press return to continue

The outcome is well-described in the previous section. The only differences between the results from program FIELD and this program are that the serial number, drop height and repeat are omitted.

As soon as this step is completed, the reduced load and deflections are written in the summary file established in the previous section (e.g. TEST9310.R15). In addition, if translation is requested, a file with the same name and extension as the file containing the raw data will be created, but with one difference. The first character of the extension will be changed to T. For example, if file TEST9310.003 is being reprocessed, the file containing the ASCII results will be TGTEST9310.T03. An example of a translated file is shown in Appendix E.

In the next step, the graphics subroutines are used to create the plots of either raw or processed data. The following menu appears on the screen.

```
PLEASE ENTER THE PLOT OPTION
< 1 > RAW DATA OF CHANNEL NUMBER 1
< 2 > RAW DATA OF CHANNEL NUMBER 2
< 3 > RAW DATA OF CHANNEL NUMBER 3
< 4 > RAW DATA OF CHANNEL NUMBER 4
< 5 > RAW DATA OF CHANNEL NUMBER 5
< 6 > RAW DATA OF CHANNEL NUMBER 6
< 9 > REDUCED DATA OF CHANNEL NUMBER 1
< 10> REDUCED DATA OF CHANNEL NUMBER 2
< 11> REDUCED DATA OF CHANNEL NUMBER 3
< 12> REDUCED DATA OF CHANNEL NUMBER 4
< 13> REDUCED DATA OF CHANNEL NUMBER 5
< 14> REDUCED DATA OF CHANNEL NUMBER 6
< 19> CONTINUE COLLECTION OR REDUCTION OF DATA
< 20> QUIT
```
Any data set can be inspected on the screen. In addition, a cursor is available where the approximate coordinates of a given point can be determined. Any number of graphs can be inspected. As soon as this step is completed, the user can either utilize Option 19 to reprocess another file, or can utilize Option 20 to exit the program.
Appendix A

CALIBRAT.DFT File

File CALIBRAT.DFT is used so that the default drop heights and repeats can be conveniently introduced to the program. This file contains many lines of data. On each line two numbers should be typed free-format (i.e. the numbers can be typed with any spacing). The first number is the drop height and the second number is the repeat. It should be mentioned that these numbers are only for information. The drop heights and number of repeats applied by the FWD during calibration should be coordinated with this file. As an example, for the SHRP calibration protocol (i.e. four drop heights and five repeats at each drop height), file CALIBRAT.DFT contains:

1 1
1 2
1 3
1 4
1 5
2 1
2 2
2 3
2 4
2 5
3 1
3 2
3 3
3 4
3 5
4 1
4 2
4 3
4 4
4 5
The execution of the program will be terminated as soon as the last line of the file encountered.
Appendix B

File COMPILE.BAT

The program uses different libraries, so the program should be compiled using the "COMPILE.BAT" batch file. To compile a program simply type "Compile FIELD (or LAB)".

File "COMPILE.BAT" contains the following commands:

`FL < %1.FOR`

`LINK SE:512/ST:15383 %1.OBJ+\EDUECE.OBJ \RUL,VID+ DIC+ ATLFOR;`
Appendix C

Changing Data Acquisition Default Parameters

In Step 2, it was indicated that the set-up for each channel of the data acquisition board can be changed. In this section, the step-by-step procedure for implementing these changes are described. As a reminder, the computer screen illustrates the following.

The default values are:

Total number of channels = 8
Number of geophones = 3
Number of load cells = 3
Number of other devices = 2

Channel description

<table>
<thead>
<tr>
<th>Channel</th>
<th>Gain</th>
<th>ID</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>G1</td>
<td>GEO 1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>G2</td>
<td>GEO 2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>G3</td>
<td>GEO 3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>L1</td>
<td>LCEL 1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>L2</td>
<td>LCEL 2</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>L3</td>
<td>LCEL 3</td>
</tr>
</tbody>
</table>

Time span for collecting data (Seconds) = 0.1250
Data points per channel = 256
Any changes to default values (Y/N)?

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If the response to this question is “YES” (or “Y”), the following series of questions has to be responded to.

**DO YOU WANT TO READ DEFAULT VALUES FROM A FILE (Y/N)?**

If in the previous executions of the program a file containing new default values was created (see below to learn how to create default files), the new default values can be conveniently introduced to the program through this option. The program will simply ask for the filename containing the default values and the execution will be transferred to Step 3 in the main text.

If this option is not utilized, the software will continue with:

**WHAT VALUES DO YOU WANT TO CHANGE**

- `<S>` TIME SPAN FOR COLLECTING DATA
- `<N>` NUMBER OF DATA POINTS
- `<A>` ALL VALUES

If Option "S" is selected, the following will appear on the screen:

**FOR FWD DEVICE, TIME SPAN OF 0.125 Sec IS RECOMMEND. DO YOU STILL WANT TO CHANGE IT (Y/N)?**

For a negative response, the remainder of questions will be canceled. For a positive response, the following question will appear:

**ENTER TIME SPAN FOR COLLECTING DATA (Sec)=**

Of course, the desired time span is input.

If Option "N" is selected. The following question will appear:

**ENTER THE DESIRED NO OF DATA POINTS PER CHANNEL (256,512,1024):**

The number of desired data points should be input. In this version of the program only three options are available 256, 512 and 1024 as indicated by the program.

If Option “A” is selected, all of the above questions will sequentially appear. Finally, the changed parameters can be saved in a file for future use. To take advantage of this option, these two questions should be answered.

**DO YOU LIKE TO SAVE CHANGED VALUES IN A FILE (Y/N)?**

**INPUT FILE NAME FOR NEW DEFAULT VALUES**
Appendix D

Typical Output from Program FIELD
Appendix E

Typical Output from Program LAB
Appendix F

A Graphical Description of Device
Calibration System Packaged for Shipment
(The portable computer is carried separately)
The cables with black covers should be used to connect the load cells to the signal conditioning unit. The cables with red covers should be connected to the connectors labeled GEOPHONES. It is extremely important that the numbers on the cables match the numbers for load cells and geophones. The trigger unit should be connected to the DIN connector labeled TRIGGER.

If a load cell is not connected properly to the signal conditioning unit, the yellow indicator associated with that load cell will illuminate. If a load cell cable is damaged, the corresponding red indicator will illuminate. If during field tests, the red indicators "blink", either the cables have gone bad or the nominal capacity of the load cells is exceeded.

The indicator labeled POWER should continuously illuminate for the system to be operational. In this case, the system is powered.

The green indicator labeled TRIGGER will only illuminate when data is being collected.
Well-Calibrated Geophones Used for Calibration

Note that the numbers on top of the geophone should be matched with the appropriate channel of the signal conditioning unit.
Load Calibration Unit

The base plate with three embedded load cells should be covered with the top plate and should be placed under the FWD load plate. Before impacting the unit, the cables should be moved away from the plate. Under no circumstance, the unit should be impacted without a rubber pad glued to the bottom of the base plate. The load cells should be connected to corresponding BNC cables with black jackets. The numbers on the load cells and the cables should match.
Front View of Signal Conditioning Unit

The front panel contains receptacles for three load cells, three well-calibrated, and a trigger device. Indicators lights, which are provided to show the status of the system, are described in the Close-up picture of the unit.

Rear View of Signal Conditioning Unit

The rear panel contains: 1) a 50-pin connector used to connect the signal conditioning unit to the data acquisition board; 2) an on/off switch; and 3) a standard 110 v plug.