## Using a Geometrics Seismograph to Quantify Vibrations

We get occasional calls asking how to use one of our seismographs as a vibration monitor. The method for this is described below, but it should be noted that while true amplitudes can be obtained, this method of measuring them would probably not stand up in court. True vibration monitors – seismographs designed specifically for this task – have a built-in geophone. The voltage output of the geophone per unit vibration is known to a very high degree of accuracy, and the system is calibrated by the manufacturer regularly (usually once a year). If you are measuring vibrations in a situation in which litigation might be involved, you should use a true vibration monitor. One of the more popular ones is the <u>Blastmate</u> by Instantel.

Vibrations are generally quantified in units of particle velocity, the first derivative of displacement. Geophones are particle velocity sensors – output is directly proportional to particle velocity. If you know the response function (sensitivity) of your geophone – the voltage output per unit velocity input – you can convert voltage (as measured by the seismograph) to mechanical vibration in terms of particle velocity. The sensitivity of your geophone can be obtained by the geophone manufacturer, and will be expressed as a function of frequency. A typical graph of geophone sensitivity is shown below:



It is best to used a geophone that has a natural frequency at or lower than the lowest frequency of interest.

Seismic data files are stored in a SEG format. The first step is to convert the SEG output of the seismograph to an ASCII columnar format.

If you are using an ES-3000 or Geode, your controller PC should have this icon on the desktop:



If not, it should be here: C:\Geometrics\Seismodule Controller\Tools

You can also download it from here: <u>ftp://geom.geometrics.com/pub/seismic/Geode-NZ/</u> The file is named tape.exe.

Run the program and click on **File>>Open**:

File       Tape       Display       Window       Help         Open       Ctrl+O       Image: Ctrl+P       Parameters       Values         Print       Ctrl+P       Parameters       Values         Print Setup       Image: Ctrl+P       Parameters       Values         Print Setup       Image: Ctrl+P       Parameters       Values         Save Displayed Data To Ascii File       UmBER OF CHANNELS       Parameters       Values         Exit       Image: Correct Values       Image: Correct Values       Parameters       Values         Exit       Image: Correct Values       Image: Correct Values       Parameters       Values         Image: Correct Values       Image: Correct Values       Image: Correct Values       Parameters       Values         Exit       Image: Correct Values       Image: Correct Values       Image: Correct Values       Image: Correct Values         Image: Correct Values       Image: Correct Values       Image: Correct Values       Image: Correct Values       Image: Correct Values         Image: Correct Values       Image: Correct Values       Image: Correct Values       Image: Correct Values       Image: Correct Values         Image: Correct Values       Image: Correct Values       Image: Correct Values       Image: Correct Values	🚾 tape - Tape1		
Print:       Ctrl+P         Print Preview       IME         Print Setup       ILE         Save Displayed Data To Ascii File       IMBER OF CHANNELS         IMBER OF CHANNELS       AMPLE INTERVAL (ms)         Exit       RECORD LENGTH (samples)         TRIGGER DELAY (ms)       IST ACQUISITION FILTER         ZND ACQUISITION FILTER       MISC INFO         FILE FORMAT       FILE FORMAT	File Tape Display View Window Help Open Ctrl+O		
Tape1	Print Ctrl+P Print Preview Print Setup Save Displayed Data To Ascii File Exit	PARAMETERS V IME ILE INE NUMBER VUMBER OF CHANNELS SAMPLE INTERVAL (ms) VECORD LENGTH (samples) TRIGGER DELAY (ms) 1ST ACQUISITION FILTER 2ND ACQUISITION FILTER MISC INFO FILE FORMAT	ALUES
Deep ap existing document	Open an existing document		

🆚 tape - Tape1		
File Tape Displa	ay View Window Help	
2 3 ?		
Channel Gain	AGC wnd Overlap PARAMETERS VALUES	
0 🗃 0 📑	Open ?X	
	Look in: 🗀 sample_refraction_data 🛛 🔽 🗲 🗈 📸 🎫	
	1000.DAT 1003.DAT 1004.DAT 1005.DAT 1006.DAT 1008.DAT	
	File name:     Open       Files of type:     Seismic SEG-2 File (*.dat,*.sg2)         Cancel	
Ready		

Read in the file you wish to convert to ASCII.

Now, click on File>>Save Displayed Data to Ascii File:

🕫 tape - Tape1		
File Tape Display View Window Help		
Open Ctrl+O	_ <b>→₩                                    </b>	1
Print Ctrl+P Print Preview Print Setup Save Displayed Data To Ascii File Exit	PARAMETERS IME ILE INE NUMBER JUMBER OF CHANNELS JAMPLE INTERVAL (ms) RECORD LENGTH (samples) TRIGGER DELAY (ms) 1ST ACQUISITION FILTER 2ND ACQUISITION FILTER MISC INFO FILE FORMAT	VALUES Thursday, September 05, 1996 at 12:36: 1003 00-00 24 0.063 2048 0 OUT OUT SEG-2
Tape1		
Channel: 1 2 3 4 Gain: 50 48 43 37	5 6 7 8 9 10 11 24 24 33 45 49 52 54	12 13 14 15 16 17 1 58 60 63 64 61 61 6
0.00		

Export Data Settings		×
Format Export Channel Num	ber 🔽 Convert data to mV (Use Descaling Factor)	
<ul> <li>Export Data In Colur</li> <li>Export Data Of Each</li> </ul>	nn Separated By TAB 💌 I Channel In Separate Files	
Ascii Output File Name:	1003.txt Save as	
	Export Cancel	

After making your format choices (be sure to convert to mV), press **Export**. The record will be written in an ASCII format that can then be imported to Excel. From here you

can calculate the frequency spectra and particle velocities using the response function of the geophone.