



Operations Manual

Edition 1.0

Manufactured By:

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ABOUT THIS MANUAL

Congratulations on your acquisition of the HandiTrap VOD Recorder, manufactured by MREL Specialty Explosive Products Limited (MREL). The instructions in this Operations **Manual** serve as a reference for the operation of the HandiTrap for recording the continuous velocity of detonation (VOD) of explosives and hole/deck delay times. The Operations **Manual** is divided into the following Chapters:

CHAPTER 1: GETTING STARTED

This Chapter assists those new to the operation of the HandiTrap to ensure that:

1. All of the HandiTrap hardware has been received.
2. The HandiTrap Advanced Analytical Software for Windows is installed and that communications is confirmed between the Operator's computer and the HandiTrap.
3. The HandiTrap Advanced Analytical Software for the Palm Operating System (PalmOS) is installed and that communications is confirmed between the Operator's computer and the Palm device.

CHAPTER 2: INTRODUCTION

This Chapter addresses the general features of the HandiTrap. It outlines some safety considerations related to the use of instrumentation in a blasting environment; and describes the main field applications of the HandiTrap for recording the VODs of explosive samples.

CHAPTER 3: HANDITRAP HARDWARE

This Chapter covers issues related to the various hardware components of the HandiTrap. It briefly describes the main features of the HandiTrap's front panel; provides details on the HandiTrap power source; and outlines instructions for recharging and long term storage of the HandiTrap. Also included is a description of the VOD **PROBEROD** resistance probe available from MREL. A summary of the technical specifications of the HandiTrap is also presented.

CHAPTER 4: RECORDING VODS

This Chapter describes issues related to VOD testing of explosives, and introduces the resistance wire technique for testing small explosive samples. Also presented are safety considerations and the setup procedure for the HandiTrap in the field.

CHAPTER 5: HANDITRAP SOFTWARE FOR WINDOWS

This Chapter presents the method for retrieving data from the HandiTrap to a computer and selecting a data file for analysis. All the features and menu functions of the Windows **Software** required for analysis and presentation are described. All the features and menu functions of the Windows **Software** required for analysis and presentation are described.

CHAPTER 6: EXAMPLES OF WINDOWS DATA ANALYSIS

This Chapter provides a detailed analysis of VOD information, starting with the selection of the data and followed by its analysis and formatting for presentation. Several examples are discussed.

CHAPTER 7: ANALYSIS ON PALM DEVICES

This Chapter also presents the method for retrieving data from the HandiTrap to a Palm device and selecting a data file for analysis. All the features and menu functions of the PalmOS **Software** required for analysis and presentation are described.

CHAPTER 8: CONTACTING MREL FOR TECHNICAL SUPPORT

This Chapter provides detailed contact information for MREL's Blasting Instrumentation Team. It also provides instructions for emailing HandiTrap files to MREL for complimentary analysis support.

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CHAPTER 1: GETTING STARTED

All of the steps detailed in this Chapter should be completed before the Operator goes into the field to conduct a VOD test:

1. Ensure that all HandiTrap components have been received and are available.
2. Install the HandiTrap Software on the Operator's computer.
3. Install the HandiTrap PalmOS Software on the Operator's Palm device (optional).
4. Ensure that the Operator's computer and HandiTrap are able to communicate with each other.
5. Ensure that the Operator's Palm device and HandiTrap are able to communicate with each other (optional).

1.1 ENSURING THAT ALL HANDITRAP HARDWARE HAS BEEN RECEIVED

Details of these hardware components are contained in **Section 3.1**.

1. HandiTrap VOD Recorder.
2. HandiTrap Battery Charger that is labeled 120 VAC or 220 VAC depending on your Country's mains power.
3. Communications Cable - serial port cable.
4. BNC Adapter.
5. HandiTrap Advanced Analytical Software on CD-ROM.
6. HandiTrap Operations Manual.
7. VOD resistance probes: **PROBERODs**.

1.2 INSTALLING THE HANDITRAP ADVANCED ANALYTICAL SOFTWARE

1.2.1 COMPUTER SYSTEM REQUIREMENTS

The HandiTrap Advanced Analytical Software, for Windows '95, '98, ME, NT, 2000, and XP has been provided on a CD-ROM. The CD-ROM also contains a medium-resolution digital copy of this Operations **Manual** in Adobe Acrobat pdf format (HandiTrap Operations Manual Edition 1.pdf). Additional copies of the Operations **Manual** may be printed for your use as required.

The **Software** operates on any Personal Computer (PC) system with the following minimum specifications:

1. Windows '95, '98, ME, NT, 2000, or XP operating system. The computer hardware required to install these is sufficient to run the HandiTrap Software smoothly.
2. 25 Mb hard drive space for **Software** and digital Operations **Manual** installation. Each data file will take up an additional 8k – 64k of space. It is recommended that 25 Mb of hard drive space be available on the computer for data and temporary files.
3. CD-ROM drive. If the computer does not have a CD-ROM drive, a set of floppy disks can be made with another computer that has a CD-ROM drive. The installation program on your CD is arranged in files of the correct size so that they can be copied to floppy disks. If the computer has Internet access, contact MREL (**Section 8.1**) for instructions on downloading the installation **Software** from MREL's Internet web site. You may also contact MREL to obtain the **Software** on floppy disks.
4. Serial port (ie: COM1, COM2, etc). Recently, "legacy-free" notebook computers have been produced which have no Serial port. These require a USB-Serial port adapter, which are easily obtained at any computer store. Some computers have no free Serial ports because they are all in use externally (mouse, UPS) or internally (modem). USB has been standard on new computers since 1998, so a USB-Serial converter will allow these to communicate with the HandiTrap. For older computers, using a converter to connect the mouse to the PS/2 mouse port will often allow the previous port to be used.

1.2.2 PALM OS DEVICE REQUIREMENTS

1. PalmOS 3.1 or higher.
2. A cradle or travel connector that has a serial connector. Some PalmOS devices (e.g. Handspring) are supplied only with a USB cradle and require a separate serial cradle. The serial cradle provided by these manufacturers will only work with the RS232 port on a computer. A third party cable made by Delorme (www.delorme.com) to connect its RS232 port GPS devices to Handspring devices is required.

1.2.3 INSTALLING THE SOFTWARE ON COMPUTERS RUNNING WINDOWS

To install the HandiTrap **Software**, start Windows and insert the HandiTrap CD into the CD-ROM drive. Run the program on the HandiTrap CD called Setup.exe and follow the screen instructions. When the installation is complete, shut down the computer and re-start it.

1.2.4 INSTALLING THE SOFTWARE ON A PALM OS DEVICE

To install the HandiTrap **Software**, start the computer which has the Palm Desktop software installed. Insert the HandiTrap CD into the CD-ROM drive. Run the program on the HandiTrap CD called PalmSetup.exe and follow the screen instructions. When the installation is complete, attach the Palm device to its cradle and run HotSync. The HandiTrap Icon will be shown on the Palm device.

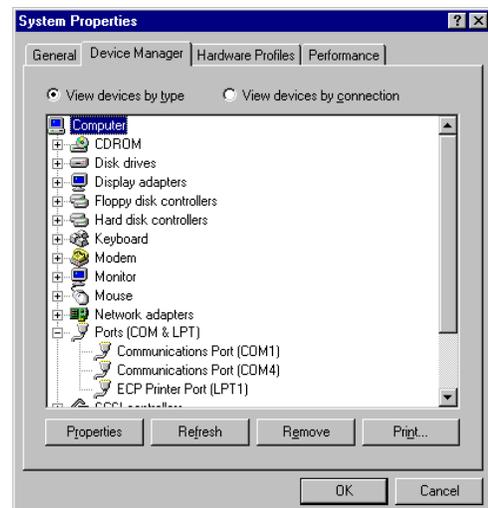


1.3 COMMUNICATING WITH THE HANDITRAP

1.3.1 COMPUTER SERIAL PORT (COM) CONFIGURATIONS

Through the Communications Cable, the **Software** is used by the Operator to download the data from the HandiTrap to the computer after testing is completed.

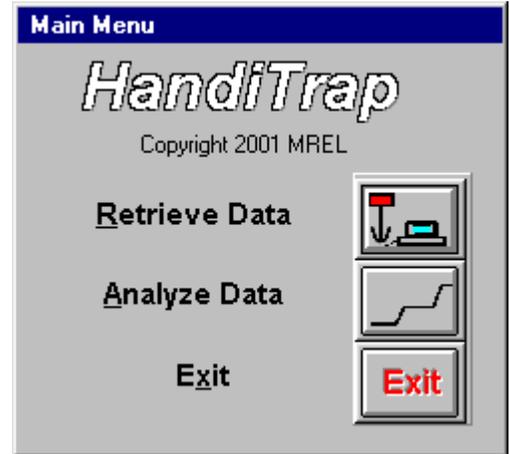
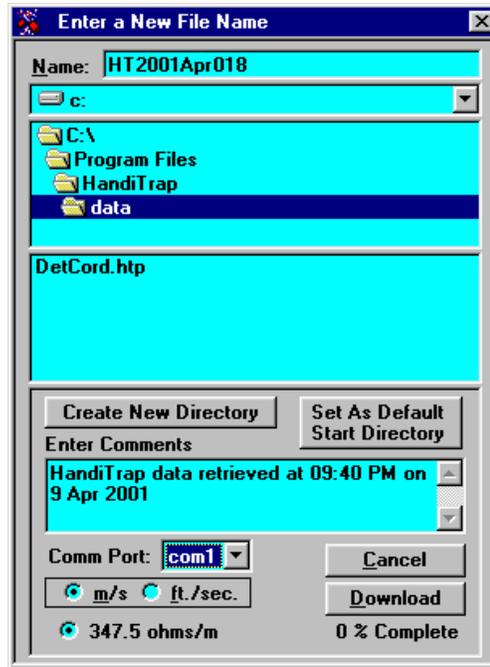
Port information for the computer can be viewed by clicking on Control Panel - System Properties and clicking on "Ports" to view the current number of serial ports.



1.3.2 TESTING COMMUNICATIONS BETWEEN THE COMPUTER AND THE HANDITRAP

In most cases, communication works at the first attempt or the problems can be solved with some consultation with MREL, but it is good practice to always ensure that a particular computer will work with the HandiTrap before taking it into the field. Conduct the following test to confirm communications:

1. Turn on the HandiTrap (with nothing connected to its BNC connector) by holding down both the **START** and **TEST** buttons for 1 second.
2. Connect the HandiTrap to the computer device using the **Communications Cable**.
3. Start the HandiTrap **Software** (Windows).
4. Press the "Retrieve Data" button in the main screen. The Operator will then be presented with the "Enter a new File Name" screen.



5. The "Comm Port List Box" sets the communications port used to download data from the HandiTrap. When the **Software** is first used, it suggests "com1", but after the first successful download, it will suggest the port that was most recently used, so the Operator will not have to set it or remember which port to use. When testing a new computer for the first time, simply try all available ports and press the Download button. **If successful communication is established, the following message will be displayed.** Go to Step 7.



6. If successful communication is NOT established, the following message will be displayed.



Press OK and test the other Com ports, per Step 5. If all Com ports result in the above message, then ensure that the procedures in **Sections 1.2** and **1.3.1** have been followed and refer to **Section 1.4** for some suggestions on troubleshooting the HandiTrap communications error.

7. Exit the **Software**.

8. Power off the HandiTrap by holding down both the **START** and **TEST** buttons for 1 second.

1.3.3 TESTING COMMUNICATIONS BETWEEN THE PALM DEVICE AND THE HANDITRAP

In most cases, communication works at the first attempt or the problems can be solved with some consultation with MREL, but it is good practice to always ensure that a particular Palm device will work with the HandiTrap before taking it into the field. Conduct the following test to confirm communications:

1. Turn on the HandiTrap (with nothing connected to its BNC connector) by holding down both the **START** and **TEST** buttons for 1 second.
2. Connect the HandiTrap to the Palm device using the **Communications Cable**.
3. Start the HandiTrap **Software** (PalmOS) and click on the **TEST** button.



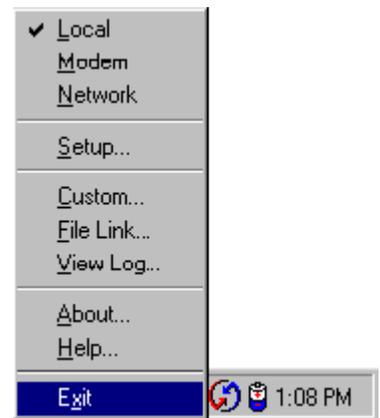
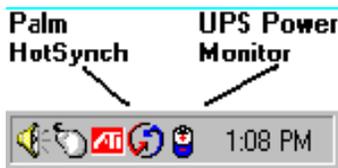
If communication cannot be established, the following will appear:



1.4 TROUBLESHOOTING HANDITRAP COMMUNICATIONS ERRORS

If all computer Com ports have been tried without success, the following may help:

1. Often the most direct solution is to use a USB-Serial cable. This works for "legacy-free" laptops that have no serial ports and for other computers that have no available serial ports for an unknown reason. When installing the software for these, pay careful note to whether you should install the driver software before attaching the adapter for the first time.
2. There may be software that is "reserving" a Com port for its own use. Usually, programs that do this are shown in the bottom right of the Windows screen. The following shows icons for the Palm HotSync program and a Un-interruptible Power Supply (UPS) monitor program both of which use a serial (COM) port.



3. To free a reserved port, exit the program that is using it. For example, to exit the Palm HotSync software, right click over the Palm icon, then choose Exit. The HotSync software can be restarted again later without having to restart the computer.
4. Software for a UPS may install a program that uses a serial cable connected to the UPS to detect if power has gone off, and then save any open files. If this software is turned off, ensure that it is turned on again after downloading has finished. Often it will return after rebooting the computer.
5. Even though there may be 2 serial ports on a computer, if it has an internal modem, it may have reserved one of the Com ports for itself, so it may be necessary to try the other serial port. If a computer has an internal modem and is using a serial mouse, there may be no available serial ports. For the short term, unplugging the mouse and plugging the HandiTrap Cable into that serial port may allow downloading. This will require using "Tab" to move from button to button and "space" to press a button.
6. If the computer will be used frequently to download HandiTrap data, a serial port can be made available by changing to a PS/2 mouse or using a USB- Serial cable to add a serial port. A serial to PS/2 converter can be used to allow the mouse to be plugged into the PS/2 port, if one is available, which will allow its old port to be used by the HandiTrap, or the Operator can use a USB mouse to free the serial port.

7. If you are using a PalmOS device, turn “beam receive” off. (This is not necessary for all PalmOS devices, but it helps some devices).
8. If you are using a PalmOS device that has been introduced very recently, it may handle serial port communications in a slightly different way than earlier devices. If you cannot download data, please check the MREL website (www.mrel.com) for the latest version of the **Software** or inform MREL about the particular PalmOS device.
9. If the above strategies do not work, please contact MREL, as detailed in **Section 8.1**, for additional technical support.

CHAPTER 2: INTRODUCTION

2.1 BACKGROUND

The HandiTrap VOD Recorder is likely the most affordable and easiest to use portable, high-resolution recorder available for testing samples of explosives.

The HandiTrap is a portable, 1 channel, high resolution, explosives continuous VOD recorder. The HandiTrap has proven its reliability under the extreme temperature, weather, dust and rugged conditions that characterize blasting environments around the world.

The HandiTrap Advanced Analytical Software allows the Operator to analyze VOD traces recorded by the HandiTrap. The **Software** is used to retrieve, display, analyze, print and export VOD data. The **Software** runs under 32 bit Windows '95, '98, ME, NT, 2000, and XP. This facilitates extremely fast data handling, and the ability to copy and paste HandiTrap graphs into any word processors and/or spreadsheets running under those Windows operating systems.

Additionally, the HandiTrap is provided with **Software** for the PalmOS so that the Operator can retrieve, display, and analyze VOD data on a Palm device without the need for a computer. This is a unique feature of the HandiTrap.

2.2 SAFETY CONSIDERATIONS



Persons not trained and/or authorized to handle explosives should not attempt to utilize the HandiTrap for monitoring explosive properties.

The HandiTrap is an easy and safe instrument to operate. However, one should be aware of the inherent risk associated with explosive's handling and familiar with working in blasting environments. For this reason, it is always recommended that knowledgeable personnel, experienced in handling explosives and familiar with blasting procedures, operate the HandiTrap when testing explosives. The standard rules of safety used with explosives should apply when monitoring VODs or other explosive parameters.

When recording VODs, the HandiTrap outputs a low voltage (less than 5 VDC) and an extremely low current (less than 50 mA) to the VOD **PROBEROD** within the explosives from the **PROBEROD** connector on the HandiTrap. This low excitation signal ensures that the HandiTrap will not prematurely initiate explosives and/or detonators.

Standard (and common sense) rules apply when it comes to the presence of electrical storms near the testing area. Due to the inherent hazards associated with blasting during these storms, in addition to the possibility of electrical interference causing false trigger signals to the HandiTrap, it is recommended to immediately suspend all blasting activities and evacuate the area. This is standard policy at most blasting operations.

2.3 APPLICATIONS OF THE HANDITRAP

The main applications of the HandiTrap include testing of explosive samples:

- Test the performance of explosives against the quality control standards set by the manufacturers.
- Measure the continuous VOD in any charge diameter under confined or unconfined conditions.
- Determine the critical diameter and critical density of an explosive charge.
- Determine the gap sensitivity of explosives.
- Measure the timing accuracy of detonators.
- Measure the continuous VOD of primers/boosters.
- Determine the minimum booster size for any explosive by measuring run-up velocities.

The HandiTrap is for testing of explosive samples only. MREL manufactures other VOD recorders used to record the VODs of explosives samples and explosives in one or more blastholes and the delay times between holes and decks of explosives. Contact MREL for information on other MREL VOD recorders that are able to test explosives in blastholes:

- Measure the continuous VOD in any hole diameter, wet or dry holes, and in any type of rock.
- Measure the continuous VOD in multiple holes per blast.
- Determine whether full detonation, low order detonation or failure occurred, and where in the explosive column it happened.
- Check VODs against manufacturers' specifications in full scale blasting environments.
- Determine the minimum booster size for any explosive by measuring run-up velocities in full scale blasting environments.
- Measure the timing accuracy of detonators in full scale blasting environments.
- Measure the effects of water, drill cuttings, and rocks, etc. trapped within the explosive mass.
- Determine the length of explosive column to use in decking operations to evaluate the effect of stemming and drill cutting dilution, water pick-up, etc. on the explosive run-up requirements.
- Determine the correct length and type of stemming material to be used between decks of explosives to prevent sympathetic detonation or explosive desensitization from occurring.

CHAPTER 3: HANDITRAP HARDWARE

3.1 HARDWARE COMPONENTS

The hardware components of the HandiTrap System include the **HandiTrap**, a **Battery Charger**, a **Communications Cable** and a **BNC Adapter**. Also included with the HandiTrap System are the **Operations Manual** and the HandiTrap Advanced Analytical **Software**. A brief description of each of the hardware components is in the following Sections.

3.1.1 HANDITRAP

The HandiTrap contains electronic circuitry and an internal rechargeable battery within a protective plastic case measuring approximately 12 x 6.5 x 4 cm (4.75 x 2.5 x 1.5 in.) and weighing 0.3 kg (0.7 lbs.). The protective case prevents damage from water, sand, snow, dust and similar harsh weather conditions. As well, the case offers resistance to high temperatures, shocks and vibrations. The HandiTrap has a convenient belt clip on the back and the front of the HandiTrap is shown to the right.

Complete instructions for the field operation of the HandiTrap hardware are provided in **Chapter 4**. The main features on the front panel of the HandiTrap are outlined below:

The **TEST** and **START** buttons pressed simultaneously for one second are used to turn the HandiTrap **ON** and **OFF**. When the HandiTrap is ON, the **START** indicator light flashes indicating that the HandiTrap is in *Active* mode.

The **LOW BAT.** indicator light flashes when the HandiTrap's internal batteries need recharging.

PROBEROD: BNC connector for the VOD **PROBEROD** resistance probe.

With a **PROBEROD** connected to the HandiTrap and the **TEST** button is pressed, a steady **TEST** indicator light indicates that the **PROBEROD** electrical circuit is OK. With a **PROBEROD** connected to the HandiTrap and the **TEST** button is pressed, a slowly flashing **TEST** indicator light indicates that the resistance in the **PROBEROD** electrical circuit is too low (such as a short circuit). With a **PROBEROD** connected to the HandiTrap and the **TEST** button is pressed, a slowly flashing **TEST** indicator light indicates that the resistance in the **PROBEROD** electrical circuit is too high (such as an open circuit).

With a **PROBEROD** connected to the HandiTrap and the **PROBEROD** electrical circuit testing OK, pressing the **START** button, turns the **START** indicator light on and puts the HandiTrap in *Monitoring* mode waiting to record the blast. After the blast, the **START** indicator light is flashing...indicating that there is VOD data ready to download to a computer or to a Palm device.

The **COM/CHARGE** port is used to connect the **Communications Cable** to the HandiTrap. The other end of the **Communications Cable** is connected to either the computer or the Palm device for retrieval of the recorded data (**Sections 5.1** and **7.1**). The **COM/CHARGE** port is also used to connect the **Battery Charger** to the HandiTrap.



3.1.2 Battery Charger

The **Battery Charger** has a specification printed on it, either 120 VAC or 220 VAC. It is used to charge the HandiTrap's internal rechargeable battery.



Contact MREL if the Battery Charger that has been supplied is incorrect for the mains voltage in your country.

3.1.3 COMMUNICATIONS CABLE

The **Communications Cable** is provided to connect the HandiTrap to a computer or to a Palm device for downloading of the recorded data. The **Communications Cable** is connected between the **COM/CHARGE** port on the front panel of the HandiTrap and the COM serial port of the computer or the Palm device. The **Communications Cable** is a standard "9 pin serial null modem" cable, so should it become misplaced, it can be replaced easily by the Operator from a local supplier.

3.1.4 BNC ADAPTER

The **BNC Adapter** is provided to facilitate easy connection between the **PROBEROD** connector on the HandiTrap to the coaxial cable (preferably RG-58/U) leading to the VOD **PROBEROD** resistance probe.

3.2 HANDITRAP INTERNAL RECHARGEABLE BATTERY

The HandiTrap has four internal AA Ni-Cad rechargeable batteries. The HandiTrap is supplied with an approved 120 VAC or approved 220 VAC **Battery Charger**, depending on the country of use. When the internal battery is fully charged, the HandiTrap can operate for 8 hours (at maximum HandiTrap power consumption) before battery recharging is required. The HandiTrap is shipped from MREL fully charged. Since some time may elapse before the HandiTrap is actually put to use, the HandiTrap may not be charged fully the first time it is used. Full operating time will be obtained when the HandiTrap is recharged. Normal charging time for the batteries is 8 to 10 hours. Leaving the HandiTrap connected to the charger for longer periods than this can reduce the "charge lifetime" of the batteries (the number of full charges it can take, normally about 300). The Operator may replace the HandiTrap's internal batteries when the battery lifetime starts to decline. Ensure that NiCad rechargeable batteries are used, since the voltage used by the charger will not work with other battery types. **Do not operate the HandiTrap while the charger is connected.**

3.3 RECHARGING THE HANDITRAP



Contact MREL if the Battery Charger that has been supplied is incorrect for the mains voltage in your country.

The procedure to recharge the HandiTrap is as follows:

Ensure that the **Battery Charger** is labeled appropriately for the AC voltage mains power available.

1. With the HandiTrap switched **OFF**, connect the **Battery Charger** between the **COM/CHARGE** port on the HandiTrap and the wall outlet.

2. Full recharging is obtained after 8 to 10 hours of charging.
3. Unplug the **Battery Charger** from the wall outlet and then from the HandiTrap.



The HandiTrap internal battery can not be overcharged. According to the battery Manufacturer's specifications, full battery pack recharging will take 8 to 10 hours. Charging for extended periods of time can lower the lifetime of batteries, but not damage the HandiTrap in any way

3.4 LONG TERM STORAGE CONSIDERATIONS

No special procedures, other than those pertaining to the internal batteries, should be taken for long term storage of the HandiTrap. In the eventuality that the HandiTrap remains idle for long periods, it is recommended to recharge the HandiTrap once per month per the procedure in **Section 3.3**. This will maintain the conditioning of the internal batteries. If the batteries lose their ability to hold a charge, replacement AA Ni-Cad batteries are widely available.



Do not use the Battery Charger if non-rechargeable (regular) AA batteries have been installed in the HandiTrap. The Battery Charger is only for use with rechargeable Ni-Cads.

If the HandiTrap batteries run out of power, and there is no time to recharge the HandiTrap batteries, the Operator can use regular disposable AA batteries as long as the Operator ensures that the **Battery Charger** is **NOT** used.

3.5 VOD RESISTANCE PROBE USED BY THE HANDITRAP

The **PROBEROD**, shown below, is a rigid probe consisting of a high resistance insulated wire placed within a small diameter, metal tube, which acts as the return lead of the circuit. **PROBERODs** are specifically designed to measure VODs of explosive cartridges and/or of short sample tubes of explosives, under confined or unconfined conditions. They are available from MREL in a standard length of 3 ft. (0.9 m) and are supplied with leads ready to be connected to the RG-58 coaxial cable, which connects to the **PROBEROD** connector on the HandiTrap. Contact MREL for additional **PROBEROD** information and ordering details.



3.6 HANDITRAP TECHNICAL SPECIFICATIONS

Number of Channels	1 channel for VOD.
Vertical Resolution	10 bits, 1 part in 1,024.
Recording Rate	1 MHz.
Total Recording Time	1 millisecond (1,024 data points).
Pre-Trigger Time	0.51 milliseconds (512 data points).
Trigger Modes	Internally on the VOD signal from the blast.
Power	Four internal rechargeable AA NiCad batteries which provide 8 hours of active operation on a full charge. Full battery recharging is obtained overnight. The HandiTrap can also be operated from four AA batteries installed by the Operator.
Components Provided	HandiTrap, 120/240 VAC Battery Charger, serial port Communications Cable, colour Operations Manual, HandiTrap Advanced Analytical Software for Windows, HandiTrap Software for the Palm™ Operating System.
Size and Weight	HandiTrap: 12 x 6.5 x 4 cm (4.7 x 2.6 x 1.6 in.) 0.3 kg (0.7 lbs.).
Environmental	Operates at -40 to +80 C (-40 to +185 F). Snow, rain, dust and sand proof. Drop proof from at least a 1 m (3 ft) height.
PC Connection and Handheld/PDA Connection	At any time after recording, the Operator can connect the HandiTrap to a computer's (COM) serial port to download and view the VOD data on a computer within 30 seconds. For handheld convenience, the Operator can also connect the HandiTrap to a handheld/PDA device such as a Palm™ handheld or Handspring™ Visor™ to download and view the VOD data on the handheld/PDA device within 30 seconds. (USB PalmOS devices require a conversion cable)
HandiTrap Software for Windows	The HandiTrap Advanced Analytical Software for Windows operates under Windows '95, '98 and NT. It provides an easy-to-use and familiar graphical-user-interface that allows the Operator to easily download the data to the computer and analyze the data. VOD data are automatically displayed as a graph of distance versus time. All Software operations are "point and click". The Software allows unlimited graphical zoom on graphs, creation of annotated sub-graphs and VOD analyses of any parts of the VOD graph. Annotating, printing, saving and export of graphs and data to other Windows software are all easily accomplished. The Operator can select Metric (m/s) or Imperial (ft./sec.) units.
HandiTrap PalmOS Software for Handhelds/PDAs	The HandiTrap Software for the Palm OS® operates on any handheld/PDA running the Palm OS® Software. It provides an easy-to-use and familiar graphical-user-interface that allows the Operator to easily download the data to the handheld/PDA, save the data and analyze the data. VOD data are automatically displayed as a graph of distance versus time. The Software allows unlimited graphical zoom on graphs and the determination of the VOD between any two data points on the graph. Operations are "pen and menu". Export of data from the handheld/PDA to a computer running the HandiTrap Software for Windows is easily accomplished. The Operator can select Metric (m/s) or Imperial (ft./sec.) units.
VOD Excitation/Safety	The HandiTrap's excitation voltage is pre-set for the maximum 10 bit resolution across the VOD PROBEROD in the explosives. All VOD operating parameters are automatically recorded by the HandiTrap with no requirement for additional instruments. The HandiTrap is physically unable to output as much as 50 mA of current to a VOD PROBEROD. The HandiTrap does not rely on "current limiting automatic fault checking systems" which may potentially fail.
VOD PROBERODS	0.9 m (3 ft.) long rigid resistance probes for use in explosive samples with the HandiTrap.

CHAPTER 4: RECORDING VODS

This Chapter provides the Operator with detailed instructions on:

1. Selecting a suitable site for testing samples of explosives.
2. Loading the PROBEROD into an explosives sample.
3. Connecting the PROBEROD to the HandiTrap to record the VODs.

4.1 SAFETY CONSIDERATIONS FOR SELECTING AN EXPLOSIVE TESTING SITE



Contact MREL for site specific recommendations for testing samples of explosives.

Care must be taken to select a good site for detonation and VOD recording of explosive samples. If convenient, permanent test sites may be constructed. A pit surrounded by an earth wall suffices as a simple detonation site. A similarly protected shelter for the HandiTrap and personnel can be constructed some distance away. The distance will depend on the amount of explosive being detonated at one time, and if the explosives are confined (hazard from steel fragments). Ensure that the area is well demarcated and that access is restricted.

If samples of explosives are to be detonated at an unprepared site, then the Operator must be careful when deciding upon what type of ground the charges are to be placed. Avoid placement on ground with stones, rubble or anything that is likely to turn into a projectile. The best surfaces are fines, sand or tailings.

It is always good practice to have maximum control over the time of firing of the test, therefore safety fuse initiation is not recommended. Electric or shock tube initiation is best with the detonator either initiating the sample of explosives or initiating the primer/booster in the explosive sample.

4.2 THE RESISTANCE WIRE TECHNIQUE FOR MEASURING VOD

The HandiTrap is capable of monitoring the continuous VOD profile along the entire length of an explosives column. The HandiTrap can measure the VOD of relatively short explosive samples such as cast boosters or explosive cartridges. The HandiTrap provides a regulated constant excitation signal to the **PROBEROD** and monitors the drop in voltage across it as the **PROBEROD** is consumed in the detonation.

The HandiTrap uses the proven continuous resistance wire technique for monitoring VODs. An MREL-manufactured **PROBEROD** of known linear resistance (i.e. ohm/m or ohm/ft) is placed axially in the explosive sample or explosive column. As the detonation front of the explosive consumes the **PROBEROD**, the resistance of the circuit will decrease in proportion to the reduction in length of the **PROBEROD**. The HandiTrap records the resulting decrease in voltage across the **PROBEROD** versus time.

The HandiTrap's Advanced Analytical Software automatically converts the recorded data into a graph of distance versus time. The slope of this graph at any position is the VOD of the explosive at that particular position. The **Software** includes menu functions that will automatically calculate and display the VOD of an explosive at any selected location in the graph.

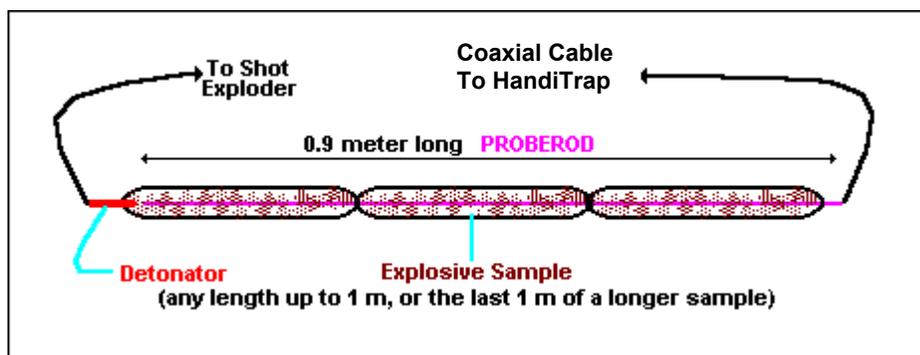
4.3 INSTALLING THE PROBEROD FOR TESTING A SAMPLE OF EXPLOSIVES

The equipment and supplies that are required to conduct VOD tests on samples of explosives or on explosive cartridges are:

1. The HandiTrap System.
2. **PROBEROD** - one (1) per explosive sample.
3. Coaxial cable (type RG-58 is recommended) - sufficient length to run between the HandiTrap location and the explosives.
4. Wire cutters and electrical tape.
5. Explosives, detonators and shot exploder.

The procedure for preparing a VOD test is as follows:

1. Demarcate the charge detonation area.
2. Place the HandiTrap in a protective shelter and/or a safe distance away from the detonation area. This distance may be closer than what is considered safe for the Operator. Once the setup is completed, the HandiTrap does not require an Operator to collect the data; it does so automatically without Operator assistance.
3. Run a length of coaxial cable from the HandiTrap to the detonation area with enough excess length to compensate for cable shortening or cable damage from each test. Shorter lengths of coaxial cable may be connected together using the wire cutters and electrical tape. A male BNC connector should be attached to the end of the coaxial cable that is to be attached to the **PROBEROD** input on the HandiTrap. A convenient **BNC Adapter** has been supplied with the HandiTrap for this purpose. The **Adapter** can be connected to the coaxial cable using the wire cutters and electrical tape. The connection should be shielding to shielding and center conductor to center conductor. Ensure that the center conductor and the shielding connections do not touch each other.
4. Note the Unit Resistance of the probe by reading the value in ohm/m or ohm/ft from the MREL factory label on the **PROBEROD**. Note the ohm/m value if the VOD is to be reported in m/s. Note the ohm/ft value if the VOD is to be reported in ft/sec. The Unit Resistance information will be requested later by the HandiTrap **Software**.
5. Insert a **PROBEROD** axially in the sample of explosives. Start at the opposite end from where the detonator will be placed as shown below.



If bulk explosives are being tested in paper tubes, plastic tubes or steel pipes which have been sealed at both ends, make a small central hole to allow the **PROBEROD** to be inserted. If a measurement of run-up to detonation is required, ensure that the **PROBEROD** is pushed well into the explosives so that it reaches the position of the detonator or booster. If the **PROBEROD** reaches the booster or protrudes past it, the effect of the booster will be recorded by the HandiTrap. The same holds true for cartridges of explosives. To test the VOD of detonation cord, tape the detonation cord along the entire length of the **PROBEROD**.

6. Connect the **PROBEROD** to the coaxial cable using the wire cutters and electrical tape. The polarity of the connection is not important.

7. At the HandiTrap end, connect the coaxial cable to the **PROBEROD** connector located on the top of the HandiTrap.
8. The **PROBEROD** installation aspects of the test are complete. The Operator can now place the detonator and connect it to the shot exploder as per standard procedures. The HandiTrap is now ready to be prepared to record the test as detailed in **Section 4.5**.

4.4 COAXIAL CABLE PROTECTION

It is important to protect the coaxial cable from damage caused by personnel and machinery operating on the blast. It is also important to protect the coaxial cable from damage caused by detonation accessories such as detonating cord, detonating relays, and shock tube bunch blocks.

The coaxial cable may be protected in many ways. Experience has shown that it is best to lead the coaxial cable under the detonating cord, detonating relays and shock tube bunch blocks and leave a barrier of sand or drill cuttings between the cable and the detonating cord. A good procedure is to protect the area where there is a cross over for about 1.5 m (5 ft) along the length of cable. Experience has shown that a sand or stemming barrier thickness of 15-30 cm (0.5-1 ft) suffices to protect the cable.

It is also a very good idea to lay the sample of explosives down on the ground as opposed to leaving it protruding vertically from the ground. This is relevant when testing cardboard or steel tubes filled with explosives. Please contact MREL for site and product specific recommendations.

4.5 HANDITRAP SETUP PROCEDURE FOR VOD MEASUREMENT

Once the **PROBEROD** has been placed in the explosive and connected to the RG-58 coaxial cable running to the **PROBEROD** connector on the HandiTrap, the Operator can start setting the HandiTrap to record VOD experiments.

The procedure to record a new VOD test consists of the following steps:

1. Ensure that the coaxial cable coming from the **PROBEROD** is connected to the HandiTrap input connector labeled **PROBEROD**.
2. Turn the HandiTrap power **ON** by simultaneously pressing the **TEST** and **START** buttons for 1 second. The **START** light will illuminate and begin to flash slowly indicating that the HandiTrap is in *Stand-by* mode.
3. If the **TEST** light flashes when no buttons are pressed, the battery needs to be recharged.
4. Press the **TEST** button; the **TEST** light will become illuminated steadily if the **PROBEROD** electrical circuit is found to be within the correct resistance range. If the **TEST** light flashes slowly or flashes quickly when the **TEST** button is pressed, then there is a problem with the **PROBEROD** electrical circuit (**PROBEROD**, coaxial cable and/or the **BNC Adapter**) and the Operator is referred to **Section 4.6** for possible solutions. It is worth noting that the **START** button will be blocked and the HandiTrap will be unable to record VODs when the **PROBEROD** electrical circuit is found to be out of the correct resistance range.
5. Press the **START** button. The **START** light will illuminate steadily. The HandiTrap then starts monitoring the blast, waiting to start collecting VOD data when the explosive is detonated causing the HandiTrap trigger signal. Personnel can now vacate the HandiTrap location.



6. When the triggering condition is met (i.e. a sufficient length of **PROBEROD** has been consumed by the detonation), the HandiTrap will trigger and start collecting VOD information.
7. Once data collection has been completed, the **START** light flashes slowly at the same rate as when the HandiTrap was first turned on, but pressing the **START** or **TEST** buttons by themselves will have no effect. **Do not switch the HandiTrap OFF at this point.**
8. The VOD data is ready to be transferred to a computer or a Palm device using the **Software** as detailed in **Sections 5.1** and **7.1**. Do not switch **OFF** the HandiTrap until the data has been transferred. The HandiTrap has a volatile memory, so switching **OFF** the HandiTrap will erase all data. The **BNC Adapter** can be disconnected from the HandiTrap.
9. Once data transfer is complete then the HandiTrap can be switched **OFF** by simultaneously pressing the **TEST** and **START** buttons for 1 second.

4.6 PROBEROD CIRCUIT RESISTANCE OUT OF RANGE

With a **PROBEROD** connected to the HandiTrap and the **TEST** button is pressed, a steady **TEST** indicator light indicates that the **PROBEROD** electrical circuit is OK. With a **PROBEROD** connected to the HandiTrap and the **TEST** button is pressed, a slowly flashing **TEST** indicator light indicates that the resistance in the **PROBEROD** electrical circuit is too low (such as a short circuit). With a **PROBEROD** connected to the HandiTrap and the **TEST** button is pressed, a quickly flashing **TEST** indicator light indicates that the resistance in the **PROBEROD** electrical circuit is too high (such as an open circuit).

The HandiTrap is only calibrated to perform VOD tests between the two initial resistance values (290 - 360 ohms).

There can be several reasons for total resistance to be LOW:

1. A short circuit somewhere in the coaxial cable and probe assembly, including any BNC connector(s) or **BNC Adapter**;
2. A damaged **PROBEROD**

Items 1 and 2 above can be tested using a blaster's galvanometer to test the resistance/continuity of the coaxial cable and **PROBEROD** assembly and solved by remaking the connections and/or replacing the damaged **PROBEROD**.

There can be several reasons for the total resistance to be HIGH:

1. An open circuit somewhere in the coaxial cable and probe assembly, including any BNC connector(s) or **BNC Adapter**;
2. A damaged **PROBEROD**

Items 1 and 2 above can be tested using a blaster's galvanometer to test the resistance/continuity of the coaxial cable and probe assembly and solved by remaking the connections and/or replacing the damaged **PROBEROD**.

CHAPTER 5: HANDITRAP SOFTWARE FOR WINDOWS

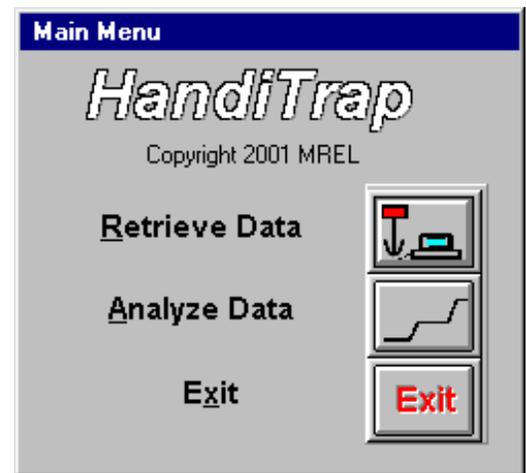


Ensure that Chapter 1 has been successfully completed prior to beginning Chapter 5.

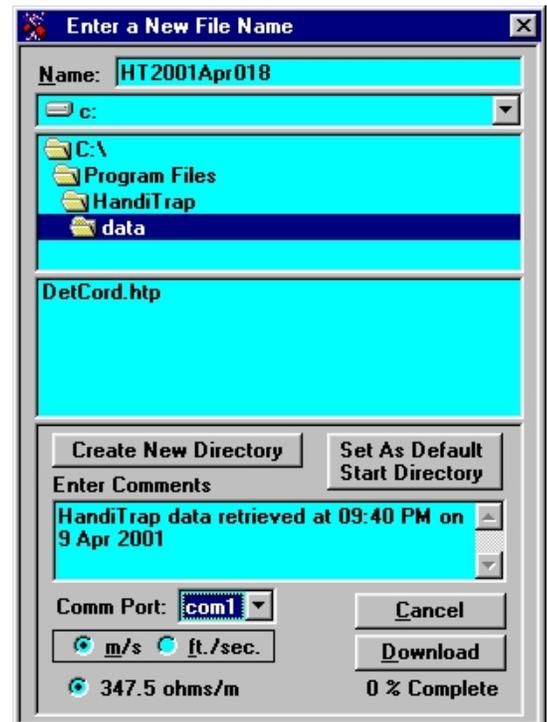
5.1 RETRIEVING DATA FROM THE HANDITRAP

The procedure to retrieve data from the HandiTrap to a computer is as follows:

1. Connect the **Communications Cable** supplied with the HandiTrap between the Serial Port on the computer and the **LPT COM** port on the front panel of the HandiTrap.
2. Turn the HandiTrap power **ON**.
3. Start the HandiTrap **Software** by clicking on **Start-Programs-HandiTrap 1.1**
4. At the Main Menu click on the **Retrieve Data** button or with the keyboard press Alt-R. Data retrieval can be accomplished without the use of a computer mouse by pressing "tab" to move between data entry fields.



5. Choose a drive, directory and file name in which the HandiTrap data will be stored. The directory defaults to C:\HandiTrap\Data. The file name, in this case, is **2001Apr018**, which indicates the 18th time data has been downloaded from the HandiTrap in April of 2001. The Operator can rename the file anything he wishes. Other HandiTrap files already stored in the directory are also displayed. Note that new directories can be created from this window using the **Create New Directory** button. As well, that the current directory can be **Set as Default Start Directory** for saving files. When all information is entered, click on the **Download** button. Otherwise, click on the **Cancel** button to return to the Main Menu. If the **Download** button is pressed and communication is established, the "% complete" will be shown until it reaches 100%.

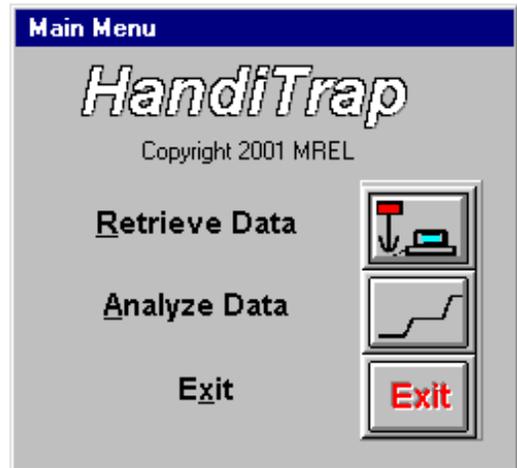


- After the data has been downloaded, the **Communications Cable** can be detached from the computer and the HandiTrap and the Operator can proceed to analyze the data.

5.2 SELECTING DATA FILES FOR ANALYSIS

The procedure to select a HandiTrap file for analysis is as follows:

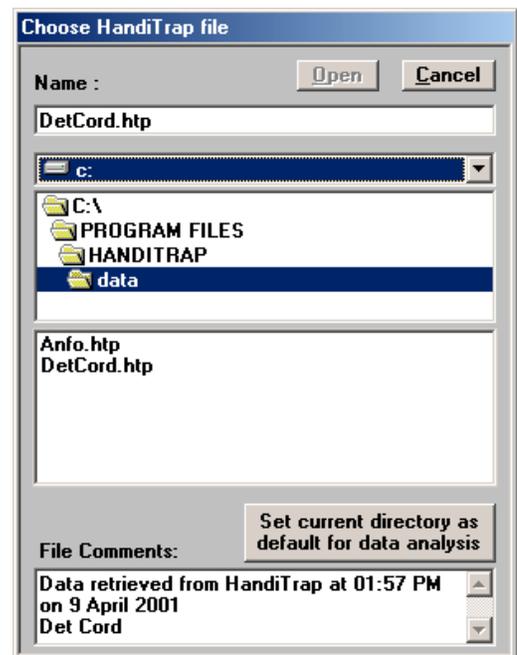
- If the HandiTrap **Software** is not running, start the HandiTrap **Software** by clicking on **Start-Programs-HandiTrap 1.1**.
- At the Main Menu click on the **Analyze Data** button or with the keyboard press Alt-A.



- Click on the file name of interest. Use the **File Comments** box as a guide to each file's content.
- Click on the **Open** button when a file has been selected, otherwise click on the **Cancel** button to return to the **Main Menu**. Note that the current directory can be set as the default directory for opening files.

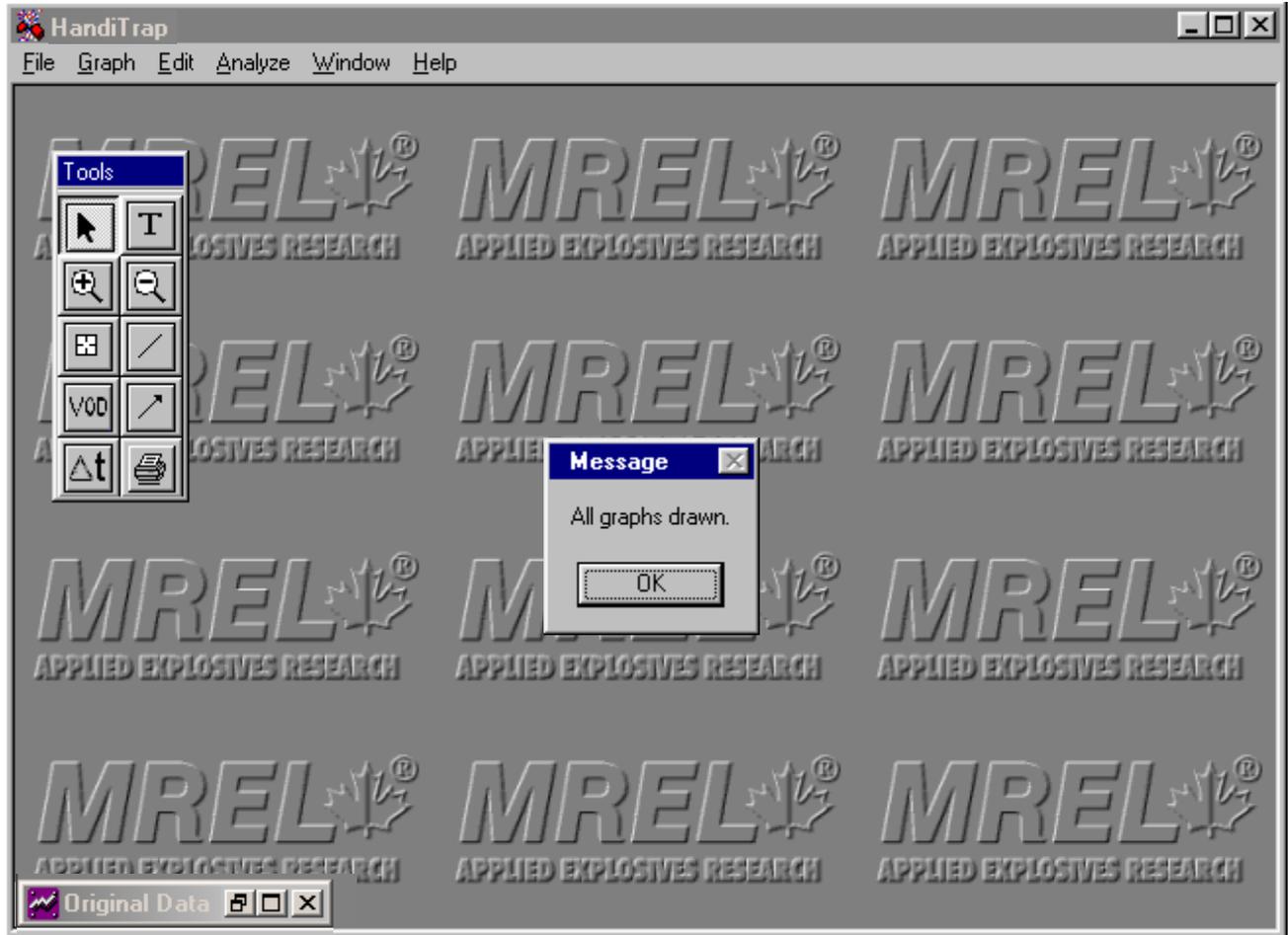
For this example, **DetCord** is chosen to illustrate the results of a VOD test on a sample of detonating cord. **DetCord** and **Anfo** are data files that have been included as examples with the HandiTrap **Software**. **Chapter 6** provides the detailed procedures for analyzing the data in both of these files.

Clicking on the **Open** button automatically starts the HandiTrap Advanced Analytical Software with the chosen data file. The following Section outlines the capabilities of the Analytical **Software**.



5.3 INTRODUCTION TO ANALYSIS

The following screen is displayed when a VOD file has been chosen for analysis and all of the sub-graphs previously saved with the file are opened:



The screen contains three main areas that are summarized below, and are discussed in more detail in the following Sections as well as in **Chapter 6**:

Desktop: the area having the MREL logo as background. One or more graphs can be displayed in maximized, normalized or minimized size states in the area.

Tools Bar: a moveable menu of icons, which allows the Operator to access analysis and graphics tools.

Menu Bar: located across the top of the screen. It includes pull down menus for File, Graph, Edit, Analyze, Window and Help.

5.4 DESKTOP

When a data file is initially opened, the Desktop area of the **Software**, which has as a background the MREL logo, shows the **Original Data** graph in a minimized state. The data and graphics on the original graphs can not be changed. New graph names must be given to the modified graphs (or sub-graphs). In this way, the original data for the test can never be lost. In the example in **Section 5.3**, the **DetCord** data file at this point in the analysis has only 1 graph, which is the **Original Data** graph.

From this **Original Data** graph, other sub-graphs can be made and saved by the Operator under new graph names. These sub-graphs can include some or all of the data in the original graph and can include graphics, text and analysis information as added by the Operator. The next time the data file is chosen for analysis, the original graph and all sub-graphs will be opened. There is no limit to the number of sub-graphs that can be created from an **Original Data** graph. The procedure for creating sub-graphs is discussed in **Chapter 6**.

By clicking on either the normalize icon or on the maximize icon on any minimized graphs (per normal Windows procedures) the data can be viewed and analyzed.

5.5 TOOLS BAR

The Tools Bar contains a selection of ten (10) tool buttons used to add or modify the graph's characteristics, text and graphics and to apply analysis procedures to the data in the graphs to calculate VODs and delay times between holes. The Tools Bar can be moved anywhere on the Desktop. The basic functions of each of the tool buttons are outlined below:



- 

The **Select Tool** has many functions including: selecting, moving, minimizing, maximizing and normalizing graphs; selecting and modifying any component of the graphs by double clicking on the component (i.e. x-axis, y-axis, data, text, titles).
- 

The **Text Tool** allows the Operator to add new text/titles/comments to graphs.
- 

The **Zoom In Tool** allows the Operator to zoom in on any part of the data and graph.
- 

The **Zoom Out Tool** restores the data to the previous range before a zooming in operation was performed.
- 

The **Data Value Tool** displays the digital x, y (time, distance) value of any data point on the graph.
- 

The **Line Tool** allows the Operator to add a straight line to graphs.
- 

The **Arrow Tool** allows the Operator to add a straight arrowhead line/pointer to graphs.
- 

The **VOD Tool** allows the Operator to automatically calculate the VOD for any part of the VOD graph by doing a linear regression on all of the data between any two data points on the graph.
- 

The **Delay Tool** allows the Operator to automatically calculate the delay time between any two data points on the graph.
- 

The **Print Tool** allows the Operator to print the active graph.

5.6 MENU BAR

The Menu Bar contains a selection of six (6) pull down menus used to open data files and their associated graphs, save sub-graphs, print graphs, export data and graphics, move and erase bad data points, arrange graphs on the Desktop and provide access to the digital HandiTrap Operations **Manual**. The Menu Bar is always located at the top of the Desktop. The basic functions of each of the pull down menus are outlined below:



The **File** menu allows the Operator to **Open** data files, display the name of the **Current** data file, **Save** the current data file including the associated graphs and **Exit** the Analysis section of the **Software**.



The **Graph** menu allows the Operator to **List** the graphs associated with the current data file, **Save** and **Rename** the sub-graphs, **Delete** the sub-graphs, **Close** the sub-graphs for the current analysis session, and **Print** the active graph.



The **Edit** menu allows the Operator to **Change the Axes** of the graph and **Copy** the **Graph** to the computer's memory for pasting into other Windows applications such as word-processors. Additionally the Operator can **Copy** the **X Data** and **Copy** the **Y Data**, which comprises the graph, for subsequent pasting into Windows spreadsheets.



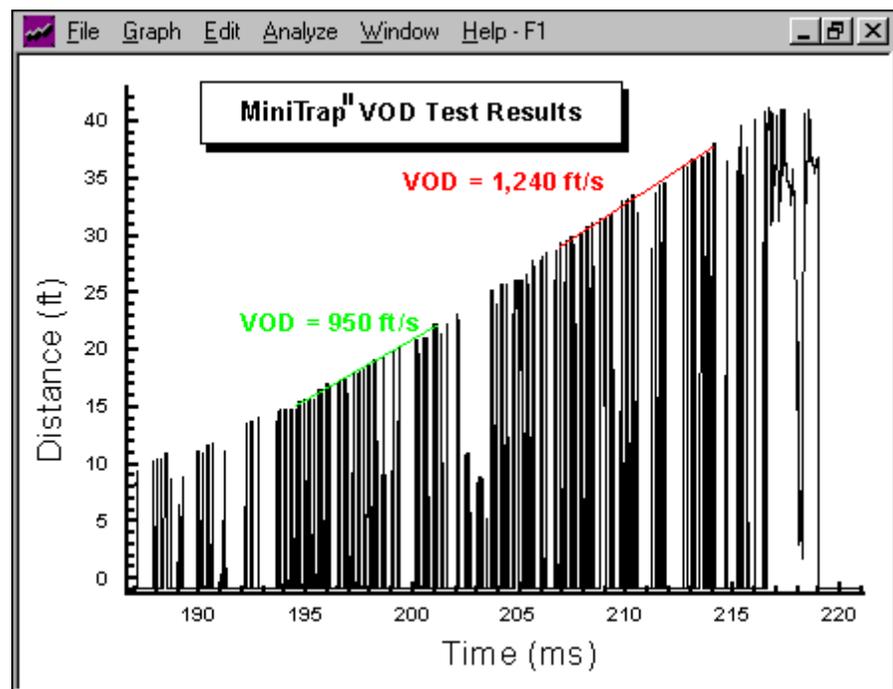
The **Analyze** menu allows the Operator to **Zoom** in on the graph, **Undo** the last **Zoom**, **Reset** the graph to full range, **Remove** bad data points, **Move** bad data points, calculate a **VOD** using **Linear Regression**, calculate a **VOD** from **2 Points** on the graph, **Remove Negative Distance Changes** on a graph, calculate a **Y value Difference** and calculate a time **Delay**.



The **Remove** and **Remove Negative Distances Changes** menu items can be used on data points that sometimes result from inefficient shorting of the **PROBEROD**, causing downward spikes in the data.

For example, when explosives react very slowly, there may be inefficient shorting of the probe. This may result in a graph similar to that shown which is a VOD record from a MiniTrap^{II} Explosives Continuous VOD Recorder on explosives in a blasthole. The trend of the VOD is apparent, however there are many downward spikes on the trace; this makes the normal **Calculate VOD** using the **Linear Regression** inaccurate. In such cases the Operator can **Calculate VOD From 2 Points** from the Analyze menu.

The **Remove Negative Distance Changes** item allows the Operator to improve the appearance of the graph for presentation purposes in an automated fashion.



The **Window** menu allows the Operator to automatically arrange the non-minimized graphs on the Desktop in three (3) ways: **Cascade**, tile **Vertically**, and tile **Horizontally**. This menu also allows the Operator to automatically **Arrange** the minimized graph icons.



The Help menu allows the Operator to access the Adobe Acrobat format of this HandiTrap Operations **Manual** on his computer. The Operator must have Adobe Acrobat Reader Software to read and print the Operations **Manual**. The Adobe Acrobat Reader Software is available free of charge from the Adobe Internet web site at www.adobe.com. The **Help** menu also displays information **About** the HandiTrap **Software**, including contact information for MREL.



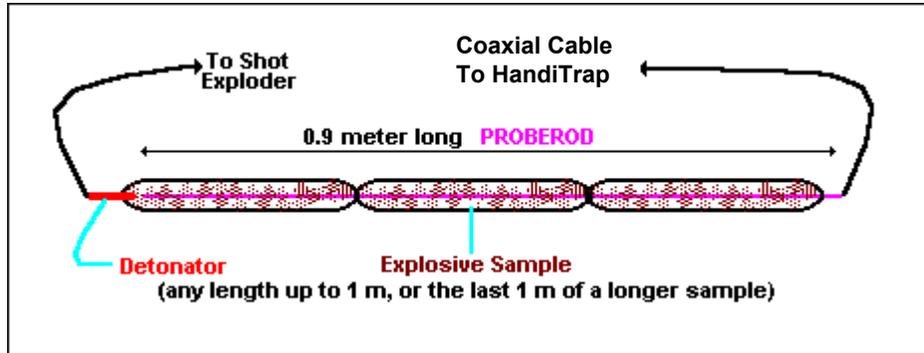
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CHAPTER 6: EXAMPLES OF WINDOWS DATA ANALYSIS

6.1 SAMPLE OF EXPLOSIVES – DETONATING CORD EXAMPLE

This Section presents a detailed analysis of a VOD test performed on a sample of detonating cord using a **PROBEROD**. The Operator is encouraged to follow the example using the HandiTrap **Software**.

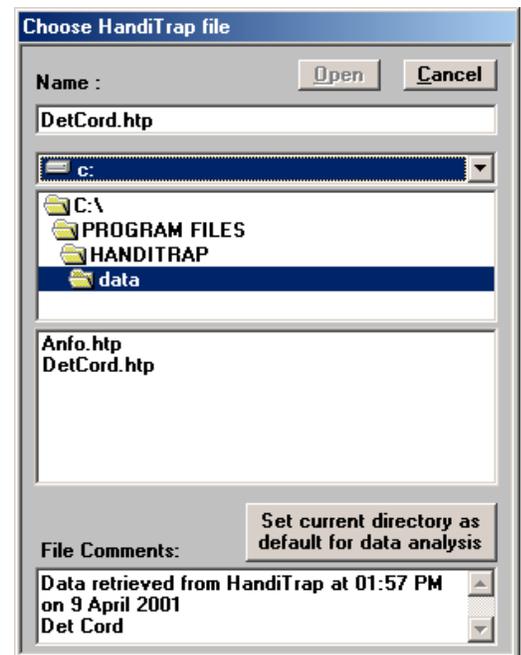
As outlined in **Section 4.3**, a typical VOD test of an explosive sample is shown below.



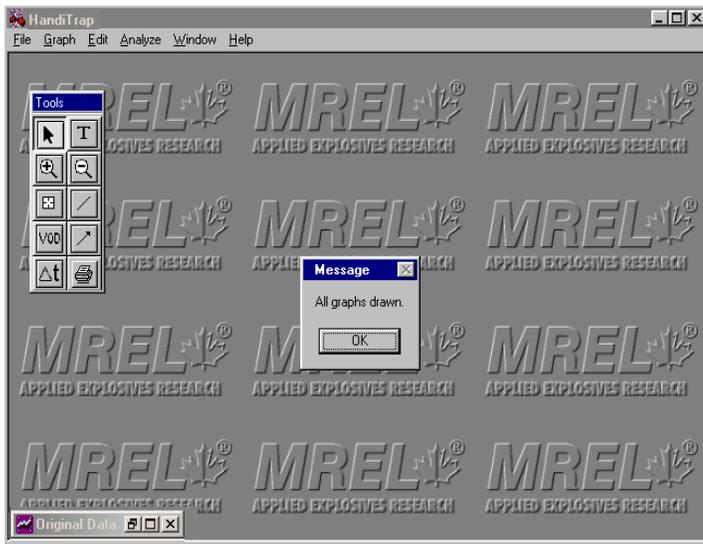
In the following example, the explosive sample is a length of detonating cord that has been taped along the length of a **PROBEROD**.

The procedure to select a HandiTrap file for analysis is as follows:

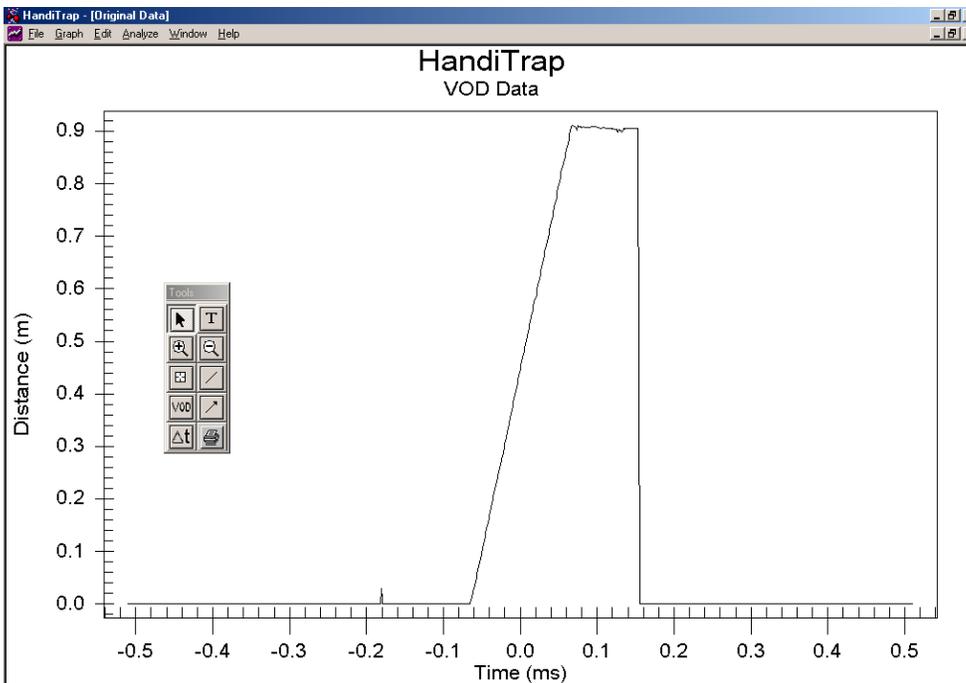
1. From the Main Menu click on the **Analyze Data** button or with the keyboard press Alt-A.
2. Click on the file name **DetCord**.
3. Click on the **Open** button, which automatically starts the HandiTrap Advanced Analytical Software.



The following window will be shown after all the graphs in the file have been loaded. Click on **OK** or press Enter.



Maximizing the **Original Data** graph, and moving the Tools Bar, results in the screen shown below:

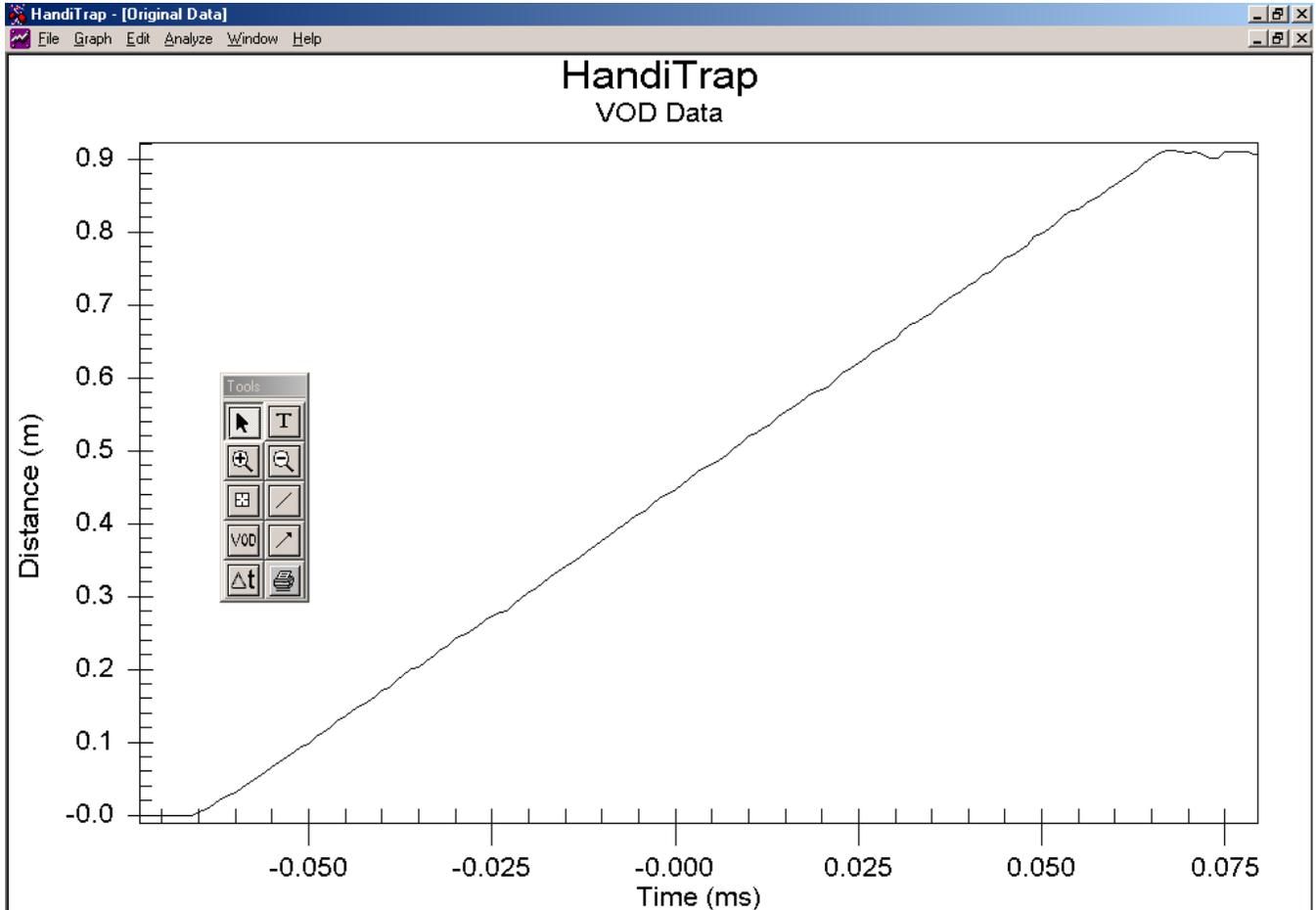


The graph shows a line plot of distance versus time for the complete duration of a VOD test. The length of the detonating cord and **PROBEROD** is approximately 0.9 m.

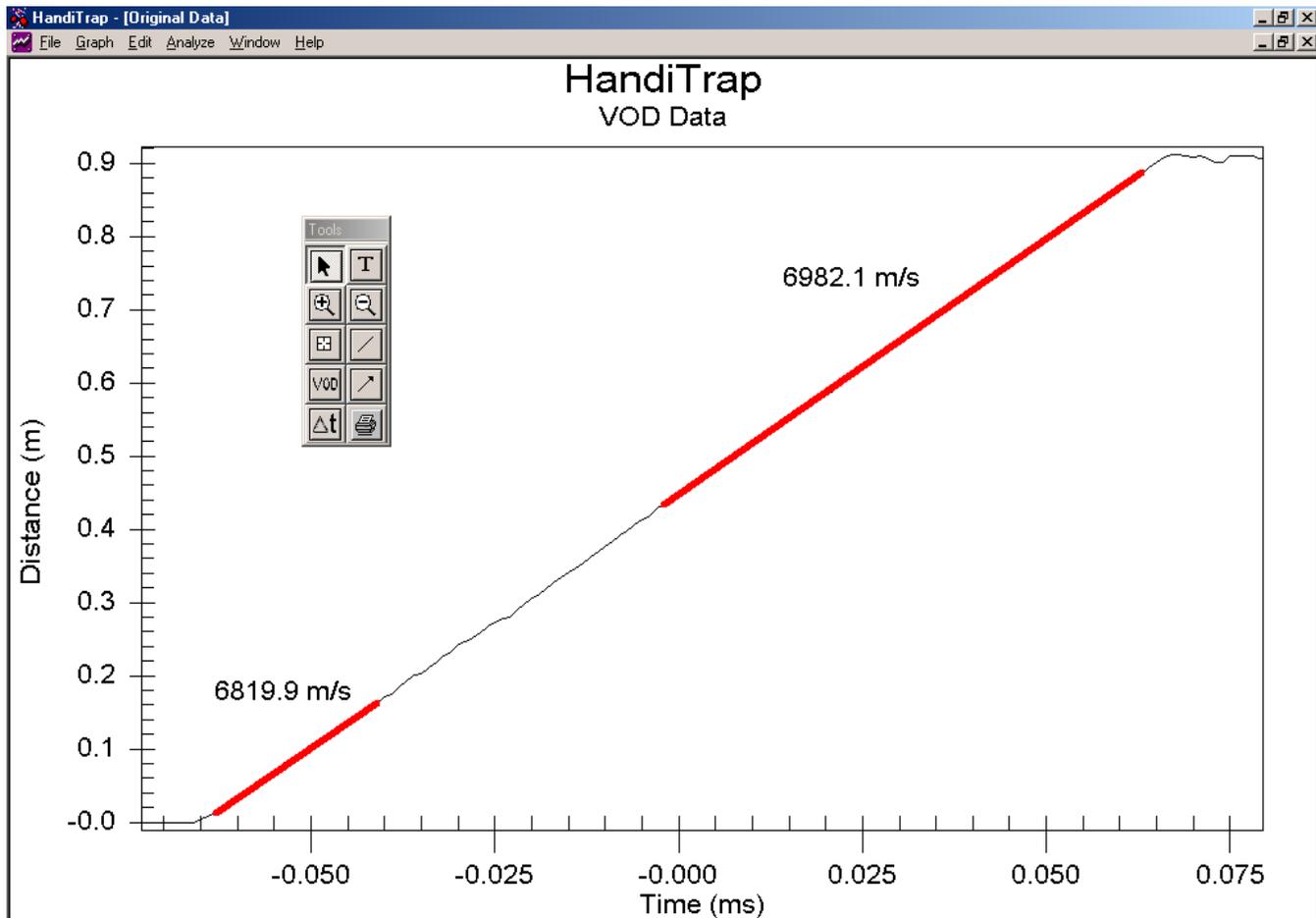
The graph has two time areas: before time = 0 (pre-trigger time) and after time = 0 (post-trigger time). In all VOD tests, the HandiTrap is triggered to begin recording at time = 0 but has a pre-trigger data memory before time = 0. This allows the HandiTrap to record the information from the **PROBEROD** as it is being consumed to the **PROBEROD** length at which the HandiTrap will trigger. The HandiTrap records post-trigger data after time = 0.

Using the **Zoom In Tool (Section 5.5)**, the Operator can focus on the area of interest: the part of the graph that shows the explosive detonating.

The following screen shows results from zooming in on the data of interest. If the wrong area is chosen, use the **Zoom Out Tool** to undo the previous **Zoom In**.



To analyze the data for VOD, choose the **VOD Tool (Section 5.5)**. The **Software** calculates the VOD by conducting a linear regression on the data contained between two data points chosen by the Operator. The **Software** prompts the Operator to click on the “first” data point and then on the “second” data point, thus defining a data range for the VOD calculation. The Operator will know when he/she is on a data point as the arrow will change to a hand. The VOD result is automatically shown with a colored straight VOD line over the data range of interest. The Operator can perform an unlimited number of VOD analyses on a graph. The VOD text can be chosen with the **Select Tool** for moving. By double clicking on the VOD text and VOD line with the **Select Tool**, the Operator can change the properties of these items or delete them.

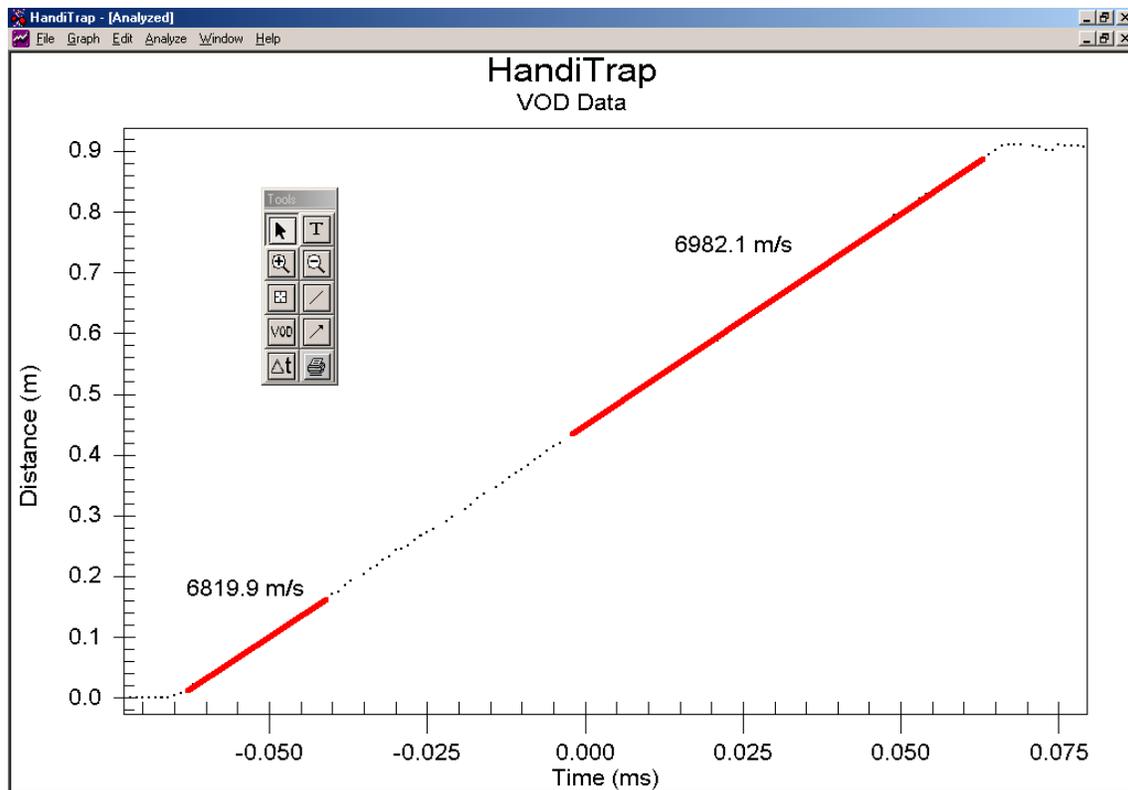
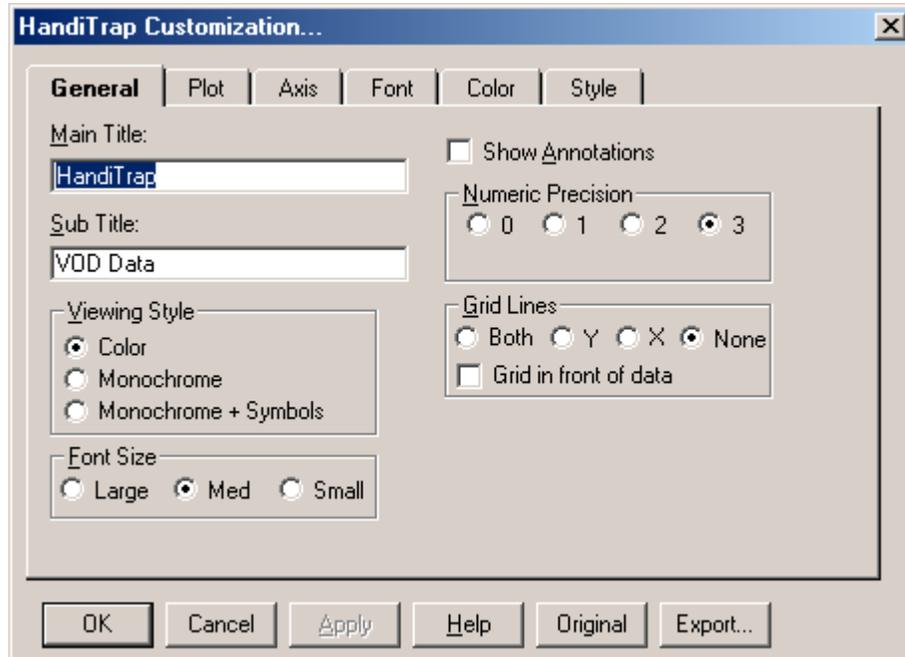


The **Text Tool (Section 5.5)** can be used to add additional comments on the graph. When the graph has been annotated to the satisfaction of the Operator, the graph can be saved as a sub-graph. The Operator cannot overwrite the **Original Data** graph that contains the original data and graphics. The Operator chooses **Graph-Save As** and then types in a name for the sub-graph. This sub-graph will be stored with the *Example* file and will be automatically opened along with the **Original Data** graph the next time the *Example* file is chosen for analysis.

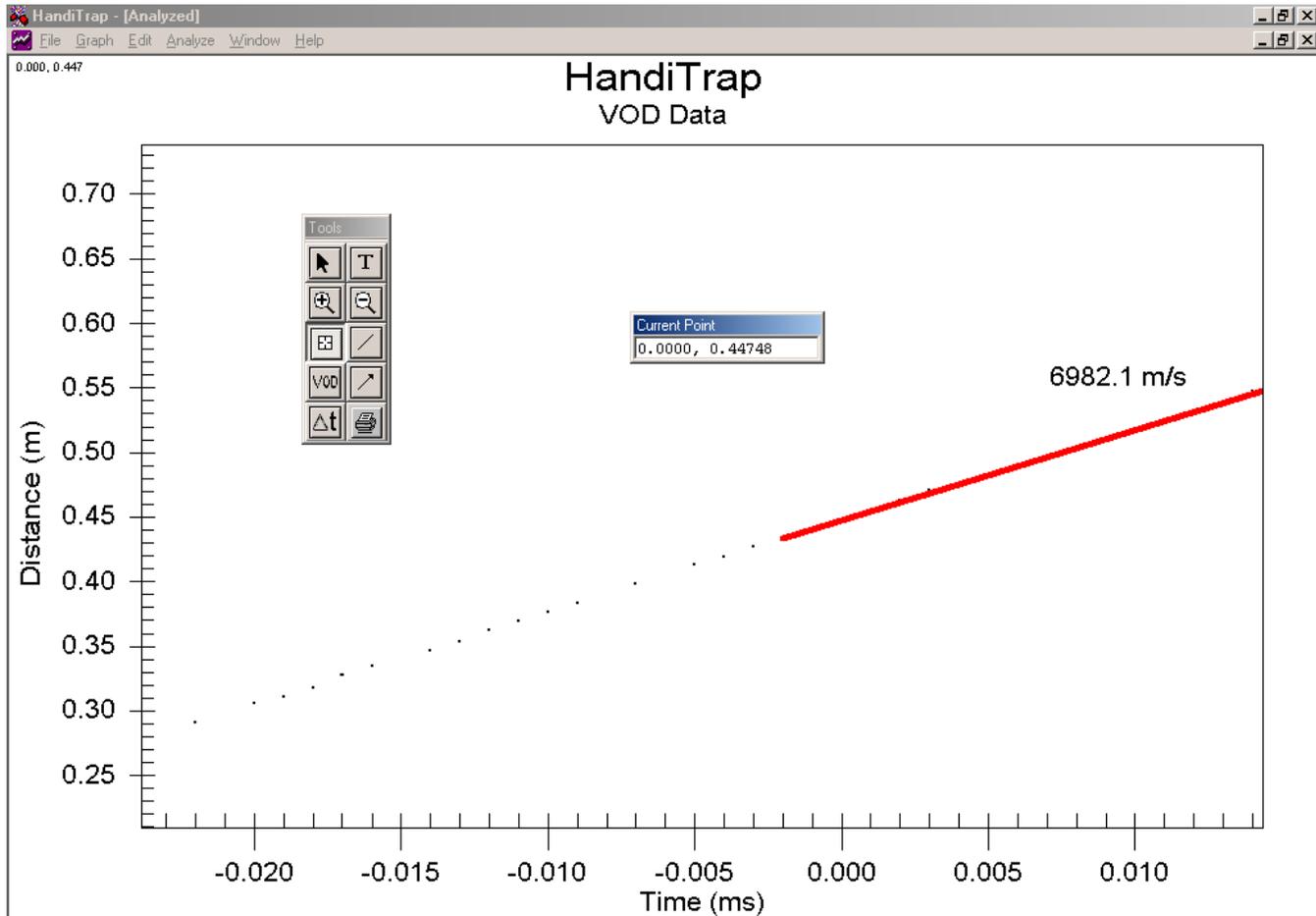
The Operator may wish to copy the graph into a Windows word-processor for a report. To do this the Operator chooses **Edit-Copy Graph** from the Menu Bar. The Operator can then minimize the HandiTrap **Software**, open the word-processor and Paste the graph.

To print directly from the HandiTrap **Software**, the Operator can either use the **Print Tool** or select **Graph-Print** from the Menu Bar.

To change the format of the graph, the x and y-axis, plot type etc... use the **Select Tool (Section 5.5)** to double click on the graph window. Double clicking with this tool on the graph window, axis titles and other objects allows some changes to be made to the attributes of these items. In the screen below, the **Select Tool** was used to double click on the graph window. The following window is displayed. Under the Plot tab, the property of the graph was changed to display data points only.



On the next screen, for interest only, the graph with the VOD analysis has been enlarged further using the **Zoom In Tool**. The **Data Value Tool (Section 5.5)** has been used to click on the graph to find the distance at which time = 0. The x, y (time, distance) coordinates of this point are shown in the **Current Point Window**. Notice that when the **Data Value Tool** is chosen, an arrow appears and in the upper left corner of the graph, the position of the arrow on the graph window is displayed (x, y). When the arrow is placed over the graph line, the arrow changes to a hand. When the Operator clicks on the graph line then the **Current Point Window** displays the value of the data point on the graph line. Note: the arrow and hand cursors are not shown on the screen below.



The Operator is encouraged to experiment with analyzing, formatting and printing the data and graphs contained in the *Example* file. Note: changes are made to the data in the sub-graphs; the **Original Data** graph cannot be changed and will always be available for subsequent analyses.

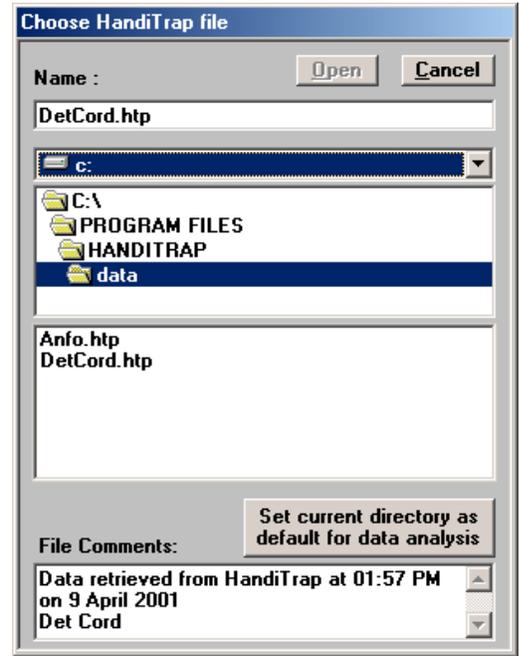
6.2 SAMPLE OF EXPLOSIVES – AN/FO EXAMPLE

This Section presents a detailed analysis of a VOD test performed on a sample of AN/FO using a **PROBEROD**. The Operator is encouraged to follow the example using the HandiTrap **Software**.

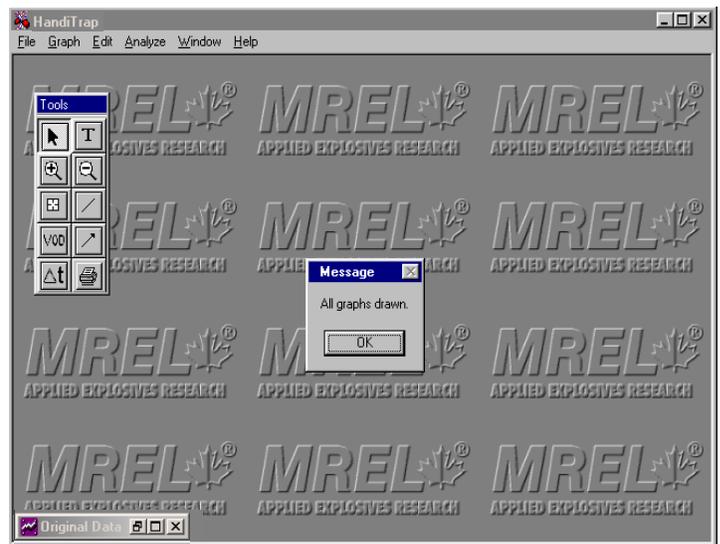
In the following example, the **PROBEROD** has been inserted into a sample of AN/FO.

The procedure to select a HandiTrap file for analysis is as follows:

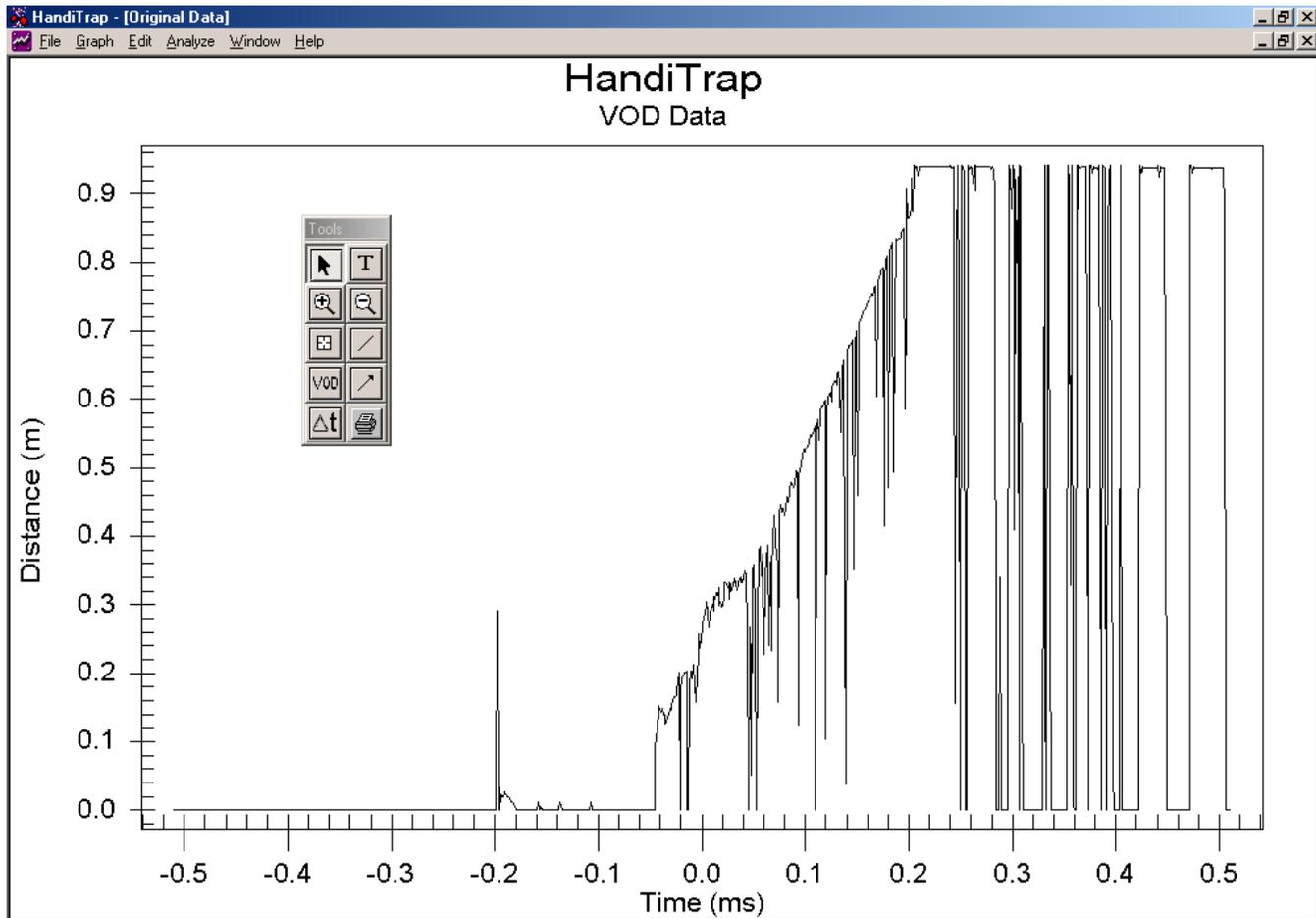
1. From the Main Menu click on the **Analyze Data** button or with the keyboard press Alt-A.
2. Click on the file name **Anfo**.
3. Click on the **Open** button, which automatically starts the HandiTrap Advanced Analytical Software.



The following window will be shown after all the graphs in the file have been loaded. Click on **OK** or press Enter.



Maximizing the **Original Data** graph, and moving the Tools Bar, results in the screen shown below:

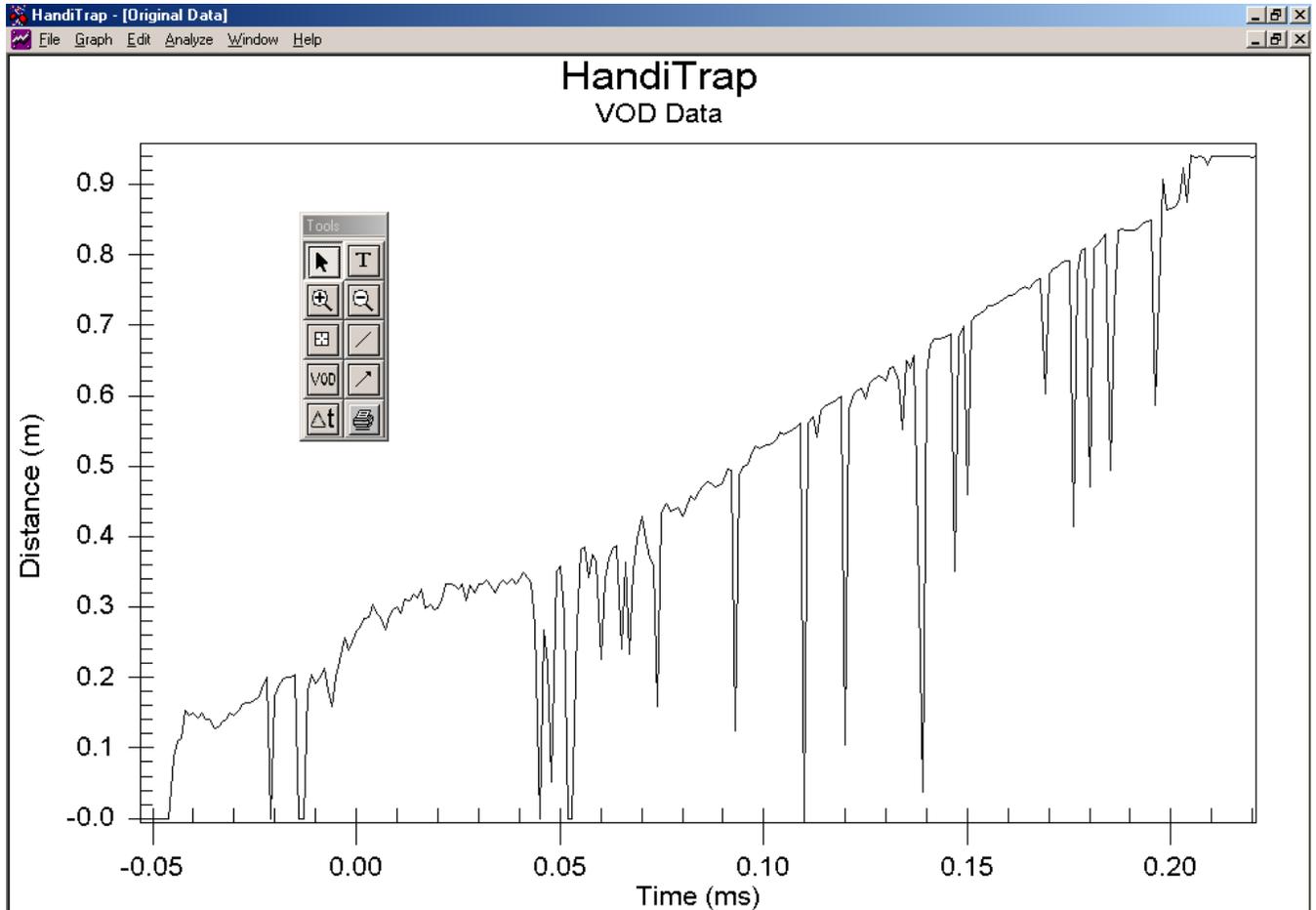


The graph shows a line plot of distance versus time for the complete duration of a VOD test. The length of the detonating cord and **PROBEROD** is approximately 0.9 m.

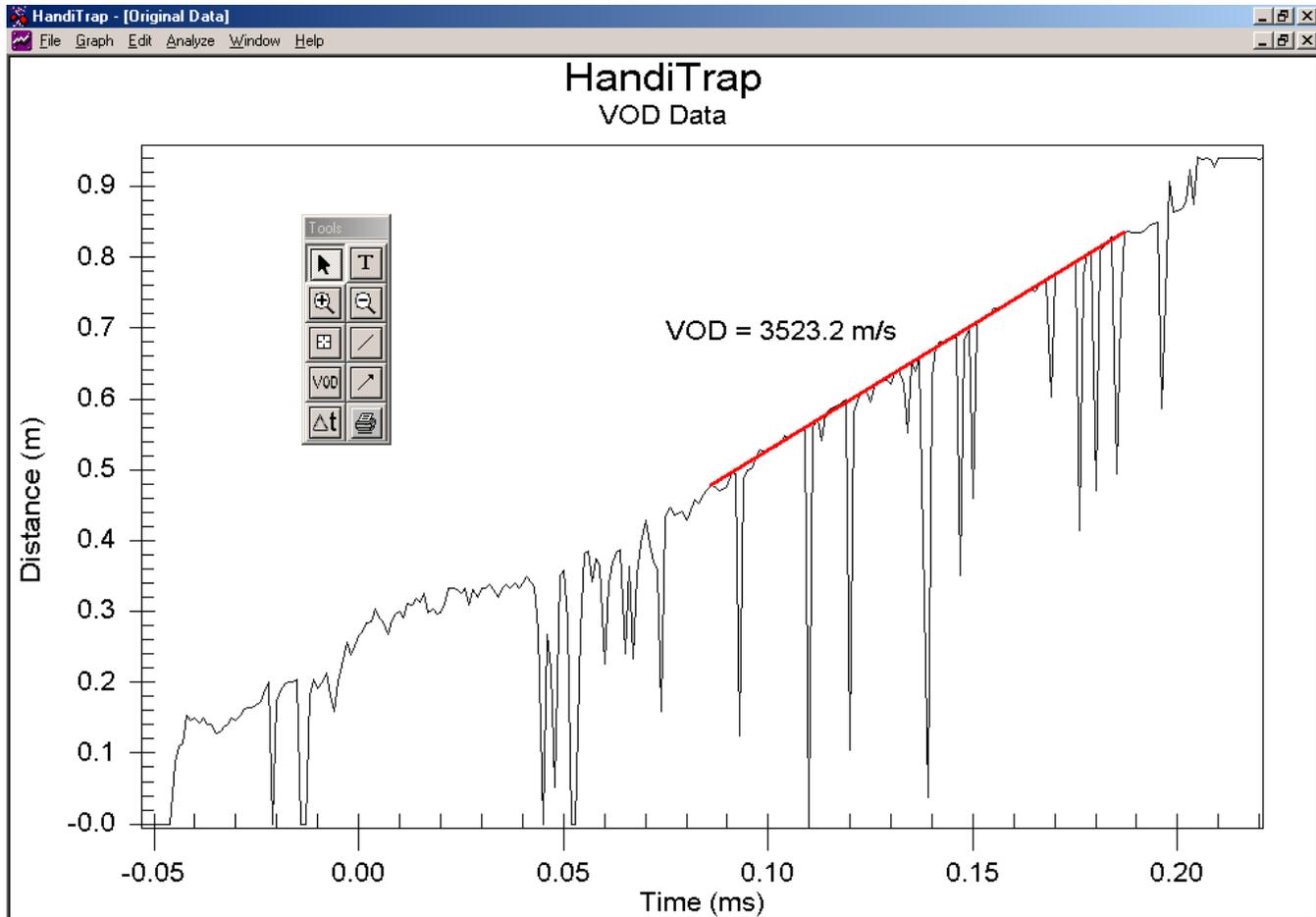
The graph has two time areas: before time = 0 (pre-trigger time) and after time = 0 (post-trigger time). In all VOD tests, the HandiTrap is triggered to begin recording at time = 0 but has a pre-trigger data memory before time = 0. This allows the HandiTrap to record the information from the **PROBEROD** as it is being consumed to the **PROBEROD** length at which the HandiTrap will trigger. The HandiTrap records post-trigger data after time = 0.

Using the **Zoom In Tool (Section 5.5)**, the Operator can focus on the area of interest: the part of the graph that shows the explosive detonating.

The following screen shows results from zooming in on the data of interest. If the wrong area is chosen, use the **Zoom Out Tool** to undo the previous **Zoom In**.



Notice that there are some downwards pointing spikes in the data. When explosives react very slowly, or if the explosive is of relatively low energy, there may be inefficient shorting of the probe. This may result in a graph similar to that shown. The trend of the VOD is apparent, however there are many downward spikes on the trace; this makes the normal **Calculate VOD** using the **Linear Regression** inaccurate. In such cases the Operator can **Calculate VOD From 2 Points** from the Analyze menu. To analyze the “noisy” data for VOD, choose the **Calculate VOD From 2 Points** from the Analyze menu. The **Software** calculates the VOD by drawing a straight line between two data points chosen by the Operator, and displaying the slope of the line. The **Software** prompts the Operator to click on the “first” data point and then on the “second” data point, thus defining a data range for the VOD calculation. The Operator will know when he/she is on a data point as the arrow will change to a hand. The VOD result is automatically shown with a colored straight VOD line over the data range of interest. The Operator can perform an unlimited number of VOD analyses on a graph. The VOD text can be chosen with the **Select Tool** for moving. By double clicking on the VOD text and VOD line with the **Select Tool**, the Operator can change the properties of these items or delete them.



The **Text Tool** (**Section 5.5**) can be used to add additional comments on the graph. When the graph has been annotated to the satisfaction of the Operator, the graph can be saved as a sub-graph. The Operator cannot overwrite the **Original Data** graph that contains the original data and graphics. The Operator chooses **Graph-Save As** and then types in a name for the sub-graph. This sub-graph will be stored with the *Example* file and will be automatically opened along with the **Original Data** graph the next time the *Example* file is chosen for analysis.

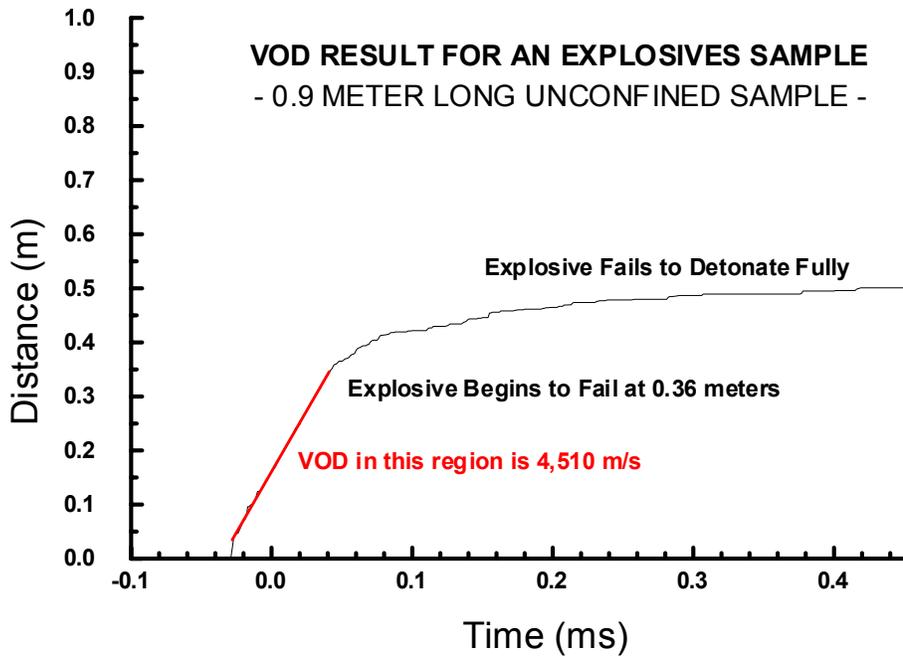
The Operator may wish to copy the graph into a Windows word-processor for a report. To do this the Operator chooses **Edit-Copy Graph** from the Menu Bar. The Operator can then minimize the HandiTrap **Software**, open the word-processor and Paste the graph.

To print directly from the HandiTrap **Software**, the Operator can either use the **Print Tool** or select **Graph-Print** from the Menu Bar.

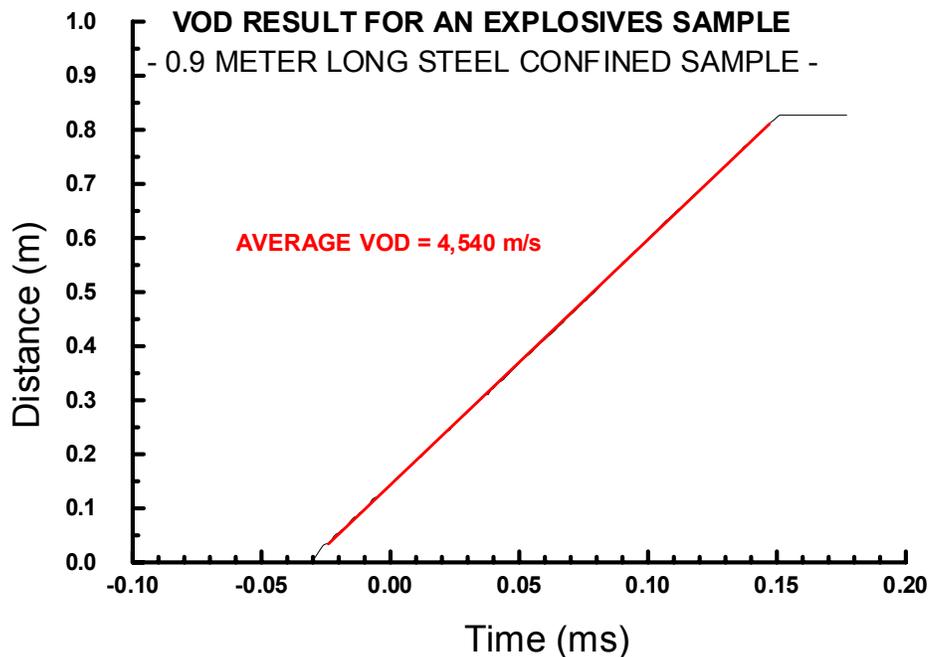
6.3 SAMPLE OF EXPLOSIVES – OTHER EXAMPLES

The following examples are provided as an illustration of the VOD analysis capabilities of the HandiTrap.

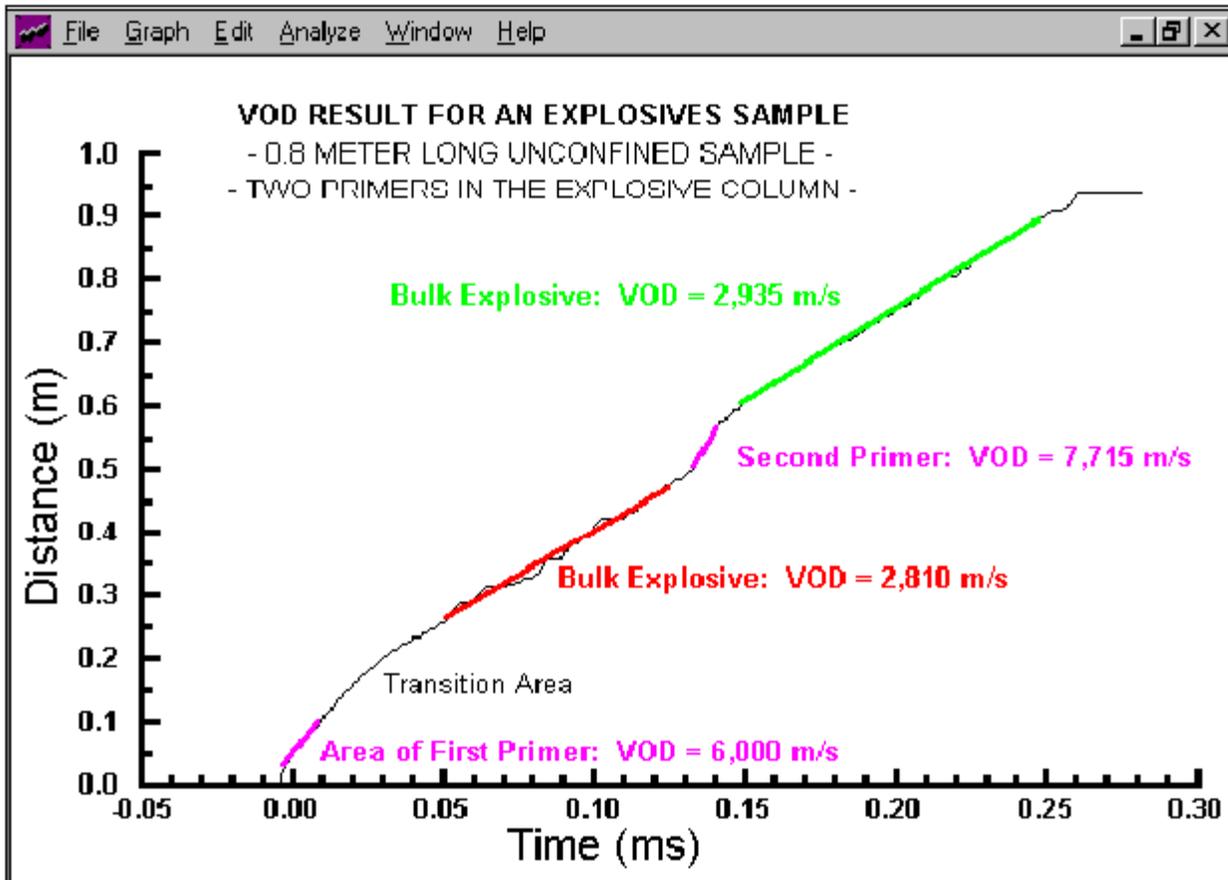
This result is typical for an explosive failing to detonate completely.



This result illustrates the effect of confining the explosive in Schedule 40 steel pipe (a standard substitute for rock). The explosive detonates fully when loaded in steel pipe but fails when unconfined as shown in the previous graph.



The following is the result of a VOD test on unconfined bulk explosive. It can be observed that a second booster was placed in the explosive column that had not been tied into the shot exploder. As can be seen, the Operator can determine the VOD anywhere along the 0.9 m long unconfined sample.



CHAPTER 7: ANALYSIS ON PALM DEVICES

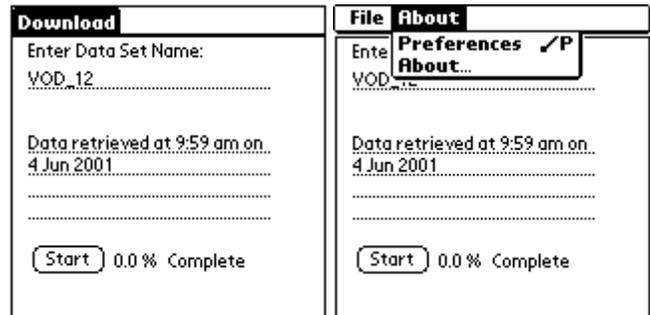
7.1 RETRIEVING DATA FROM THE HANDITRAP

The procedure to retrieve data from the HandiTrap to a Palm device is as follows:

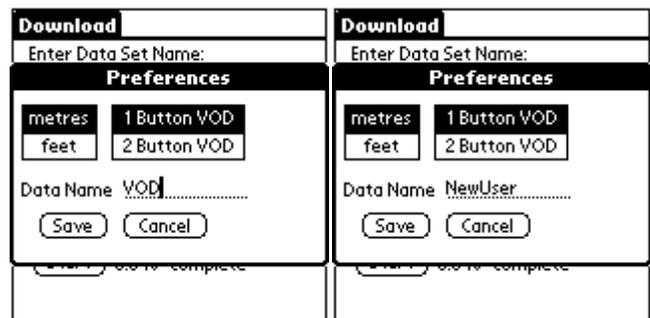
1. Place the PalmOS device in its cradle (or attach the Travel HotSync cable).
2. Connect the **Communications Cable** supplied with the HandiTrap between the Palm device and the **LPT COM** port on the front panel of the HandiTrap.
3. Turn the HandiTrap power **ON**.
4. Start the HandiTrap **Software** on the Palm device.
5. Tap the **Download** button.



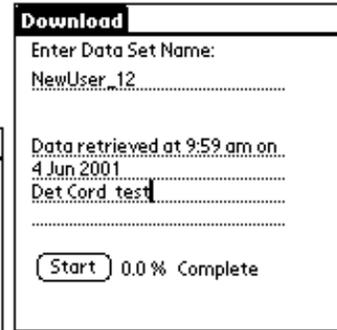
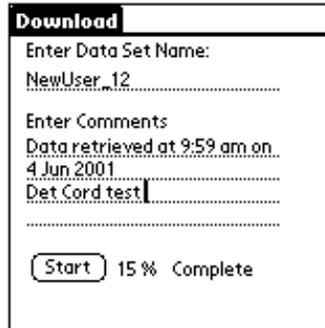
6. The Download Window will appear. The naming convention for the data files is the default of "VOD_" followed by a number to create a unique name. This can be changed by using **Menu-About-Preferences**. The Operator can also create a new name each time data is downloaded by editing the Data Set name.



7. In this example, using **Menu-About-Preferences** the Operator changes the default name of Data Sets from **VOD** to **NewUser**, which would be followed automatically by a number.
8. Also from the Preferences Window, the Operator can choose measurement units of **metres** (for VOD in m/s) or **feet** (for VOD in ft/s). Also the Operator can choose one of two method for conducting VOD analysis **1 Button VOD** or **2 Button VOD**, these are discussed in **Section 7.2**.

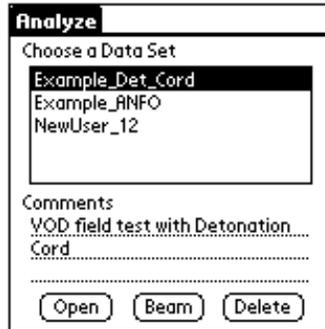


- 9. Tapping the **Save** Button returns the Operator to the Download Window. The **Software** automatically creates an initial comment from the date and time and, optionally, the Operator can add comments that are useful to describe the contents of the file when opening files for analysis.
- 10. When comments have been entered the Operator can tap on the **Start** Button to begin downloading data from the HandiTrap. The progress of the data transfer is shown as % Complete.

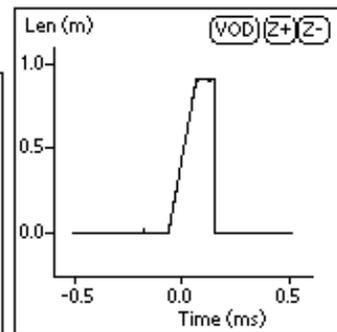
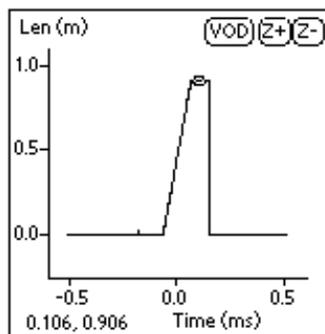


7.2 ANALYSIS

- 1. When downloading has finished, tap the **Analyze** button. The **Software** will display a list of downloaded data sets. Tapping on a name will make it the current data set and show the comments associated with it. Tap the **Open** button to view the current data set. You can also Beam or delete a data set from this window.



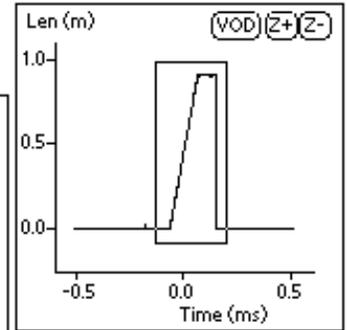
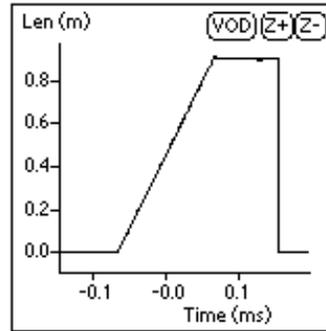
- 2. When a data set is opened the data will be graphed as shown. The graph has displays time in ms on the x-axis and length in metres or feet on the y-axis.
- 3. The Operator may tap inside the graph area to display the exact value of the nearest data point on the VOD graph. The (time, length) value is displayed in the lower left corner. Pressing the scroll up/down button on the Palm device views the next/previous data point value.



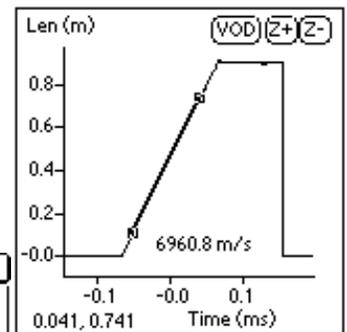
Next point

Prev point

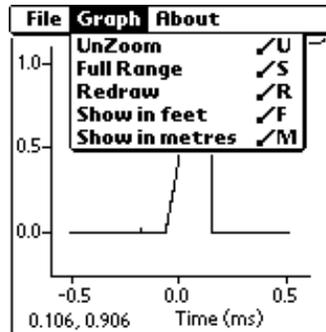
- To view the data from the detonation event more closely, tap on the **Zoom** button (**Z+**) then create a zooming rectangle by tapping at one corner of the area of interest and sliding the pen to create a “zoom rectangle”. When you lift the pen, the graph will be zoomed to that area.



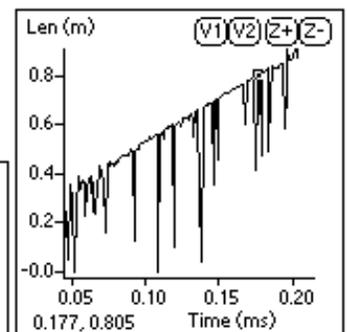
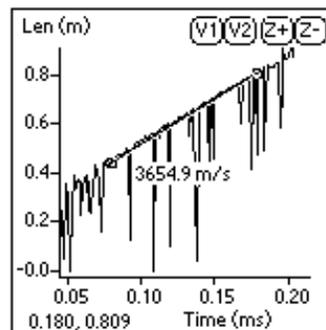
- To calculate a VOD, tap the **VOD** button, then the next 2 points selected will determine the start and end points of the VOD. (For noisier graphs, it may be necessary to choose the points more precisely with the **2 Button VOD** mode) After choosing 2 points, the VOD is calculated and looks as shown. Note that the VOD calculation is based on a straight line drawn between the two points chosen by the Operator. A linear regression on the data is not performed. For calculation of a VOD using linear regression, the Operator should use the VOD tool in the Windows **Software** as detailed in **Section 5.5**.



- At this point, the Operator can tap the **Unzoom** button (**Z-**) to return to the previous view, and calculate another VOD. There are 10 levels of **Unzoom** stored. Also, there are **Menu** functions to **Redraw** the current graph without the VOD line and text. Choosing **Full Range** will unzoom back to the original graph. **Show in feet** or **Show in metres** will redraw the graph with those units.



- Some explosives, such as ANFO, can sometimes result in noisy traces but still show a clear VOD trend. With a small resolution PalmOS device, it can be difficult to tap the exact point desired, and because of noise, the next point may have a very different value. The **2 Button VOD** mode (set in **Section 7.1**) allows the Operator to tap on the graph (or use the scroll button) as many times as needed to get the desired 1st VOD point. The **V1** button is then tapped. Next, the location for the 2nd point of the VOD is chosen, then the **V2** button is tapped, and the VOD is shown.



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CHAPTER 8: CONTACTING MREL FOR TECHNICAL SUPPORT

8.1 CONTACTING MREL

MREL Specialty Explosive Products Limited
Blasting Instrumentation Team
1555 Sydenham Road
Kingston, Ontario K7L 4V4
Canada
Toll Free Canada/USA: 1-877-544-MREL
Tel: +1-613-545-0466 Fax: +1-613-542-8029
Email: VOD@mrel.com
Web site: www.mrel.com

8.2 EMAILING HANDITRAP FILES TO MREL

It is an easy procedure to send a HandiTrap file for its analysis/review by another Operator who also has the HandiTrap **Software**.

When a file is saved on a computer, the file name takes the form of filename.filetype, otherwise known as root.extension. When a HandiTrap file is saved using a name chosen by the Operator (for example: test), several files with different filetypes are automatically created by the HandiTrap **Software** all with the same filename, test.

To email a HandiTrap file called "Example", attach the entire HandiTrap files with the same filename, to the email. It is better if all of the files are contained in one ZIP file for transfer by email, particularly if the HandiTrap data were not compressed when downloaded to your computer. Normally MREL only requires the *.htp and *.raw files to conduct an analysis. If you want MREL to review the sub-graphs you have saved containing VOD analyses you have performed on the original data, then all of the files below will be required.

For example:

Example.htp (the HandiTrap settings file, which is a readable text file). MREL requires this file.

Example.raw (the HandiTrap data file). MREL requires this file.

Example.plot001, Example.plot002 etc... (the series of sub-graph files the Operator saved during analysis)

Example.r01 (the data points removed from a sub-graph by the Operator)

Example.ml001 (the series of x values of data points moved in a sub-graph by the Operator)

Example.mv.001 (the series of new y values of data points moved in a sub-graph by the Operator)

As part of MREL's ongoing commitment to Customer Satisfaction, MREL VOD Specialists will be pleased to review your analysis of your HandiTrap data. If you would like to have a "second opinion" from MREL on your analysis of a specific test, send an email to VOD@mrel.com with a brief description of the test and attach all of the files.

MREL looks forward to providing you with assistance.

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