

Instructions for Use

***HVLab* Tactile Vibrometer**

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***HVLab* document number VPM 031**

Issue	Date	DRF No	Description	Signature
1	10/03/06	055	First Issue	SAS



Tactile Vibrometer

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1 Product Specification

The *HVLab* Tactile Vibrometer (VPM) is intended for measuring vibrotactile perception thresholds (i.e. the vibration magnitude at which a vibration stimulus can be just perceived) at various sites on the surface of the body.

The stimulus is provided by a vibrating probe at the top of the applicator. The probe protrudes through a circular hole in a height-adjustable surround. The force exerted on the surround is measured using strain gauges and feedback is provided by the force meter on the front of the control box.

During a vibrotactile threshold test the *HVLab* Tactile Vibrometer is controlled by a personal computer. The magnitude of the vibration is increased until the patient depresses the response button. The vibration magnitude is then decreased until the patient releases the response button. An automatic test programme repeats this process a number of times to establish threshold levels for perception of different frequencies of vibration. The technique is similar to that used by automatic recording audiometers.

2 Installation and commissioning

2.1 System components

If any of the following items are missing, please contact the manufacturer

- (a) Tactile Vibrometer Unit
- (b) Subject Response Button
- (c) Power Supply Unit and Power Cable
- (d) Push Force Meter
- (e) Computer Interface Cable Adaptor (or the supplied Distribution Box)
- (f) Computer Interface Cable Adaptor Interface Cable
- (g) Computer Interface Cable
- (h) 1N and 2 N weights
- (i) Computer Interface Board. Depending on your requirements, and other *HVLab* instruments connected to the same computer, you may have been supplied with either:
 - PCL 812 interface board with manual and CN2/4 extension cables
 - PCI-DAS1602/16 interface board with manual, installation software and cable adaptor

Note that only one interface board is needed to control a complete suite of *HVLab* instruments from a single computer, but if you have more than one instrument you will also need an appropriate Distribution Box (see Section 7 of this manual)

- (j) User Manual

2.2 Setting up the controlling computer and software

The Tactile Vibrometer is controlled by the *HVLab* Diagnostic Instruments Manager software, running on a suitable personal computer. The computer should have the following minimum specification:

Pentium processor (300 MHz or more)

Windows 98, Windows 2000 or Windows XP operating system

Display resolution of at least 1024x768 pixels

One available half-length ISA slot or one available full-length PCI slot

CD drive

More than 20 MB free on drive C:

Follow the instructions in Annexe A of this manual for installing the interface board and in Annexe B for installing the Diagnostic Instruments Manager Software.

As well as controlling the Tactile Vibrometer, the *HVLab* Diagnostic Instrument Manager provides database software with a simple interface for entry of patient details and health surveillance information, and for storing test results. The database has been designed to interact with the whole range of *HVLab* series of diagnostic instruments, allowing test results to be automatically added to the database. For further information on the database software see the *HVLab* Diagnostic Instruments Manager Database instructions for use.

2.3 Setting up the Tactile Vibrometer

Position the Tactile Vibrometer unit on a firm, level surface at an appropriate position and height for the subject to rest the forearm comfortably on the top of the case, with the finger over the hole in the contact plate. The balance locking mechanism should remain in the **Lock** position until the unit has been finally positioned. It is desirable to avoid using the device in rooms with suspended floors, since walking over such floors can generate perceptible vibration. The apparatus should be placed on a firm table for the same reason.

Connect the cable from the push force meter to the socket labelled **Force Meter** on the control panel of the Tactile Vibrometer unit and position the meter so that the subject can see it clearly.

Connect the cable from the response button to the socket labelled **Subject Response** on the control panel on the Tactile Vibrometer unit.

Connect the Tactile Vibrometer unit to the power supply unit using the cable provided.

Connect the computer to the Computer Interface Cable Adaptor box and the Computer Interface Cable Adaptor box (through socket labelled Vibrotactile Perception Meter) to the Tactile Vibrometer using the cables provided.

Switch on the power supply unit. An indicator light, situated immediately above the mains cable at the same end of the power supply unit as the switch should light, indicating power is available to the power supply unit. The switch should illuminate and a further two lights, situated at the opposite end of the power supply unit, should become lit. The three green power supply lamps on the Tactile Vibrometer unit should also illuminate. If the lights do not illuminate, power to the system may be interrupted, seek technical advice.

Switch on the computer and run the software.

Your *HVLab* Tactile Vibrometer is now ready for use. Please refer to the troubleshooting guide if necessary.

3 Running a vibrotactile perception threshold test

Vibrotactile threshold measurements are controlled from the *HVLab* Diagnostic Instruments Manager software. The Diagnostic Instruments Manager programme integrates the software that controls the Tactile Vibrometer, and other *HVLab* diagnostic instruments, with a relational database of subjects/patients and test results. Please read the *HVLab* Diagnostic Instruments Manager Database Instructions for Use before proceeding.

When you start the *HVLab* Diagnostic Instruments Manager software the **Control Panel** window opens as shown in Figure 1. This window is divided into three main sections – **Current Subject**, which shows the currently active record in the subject or patient database; **Diagnostic Tests**, which provides access to the individual tests and databases of test results; and **Questionnaires**, which launches a health surveillance questionnaire database, if this has been provided.

3.1 The Control Panel Window

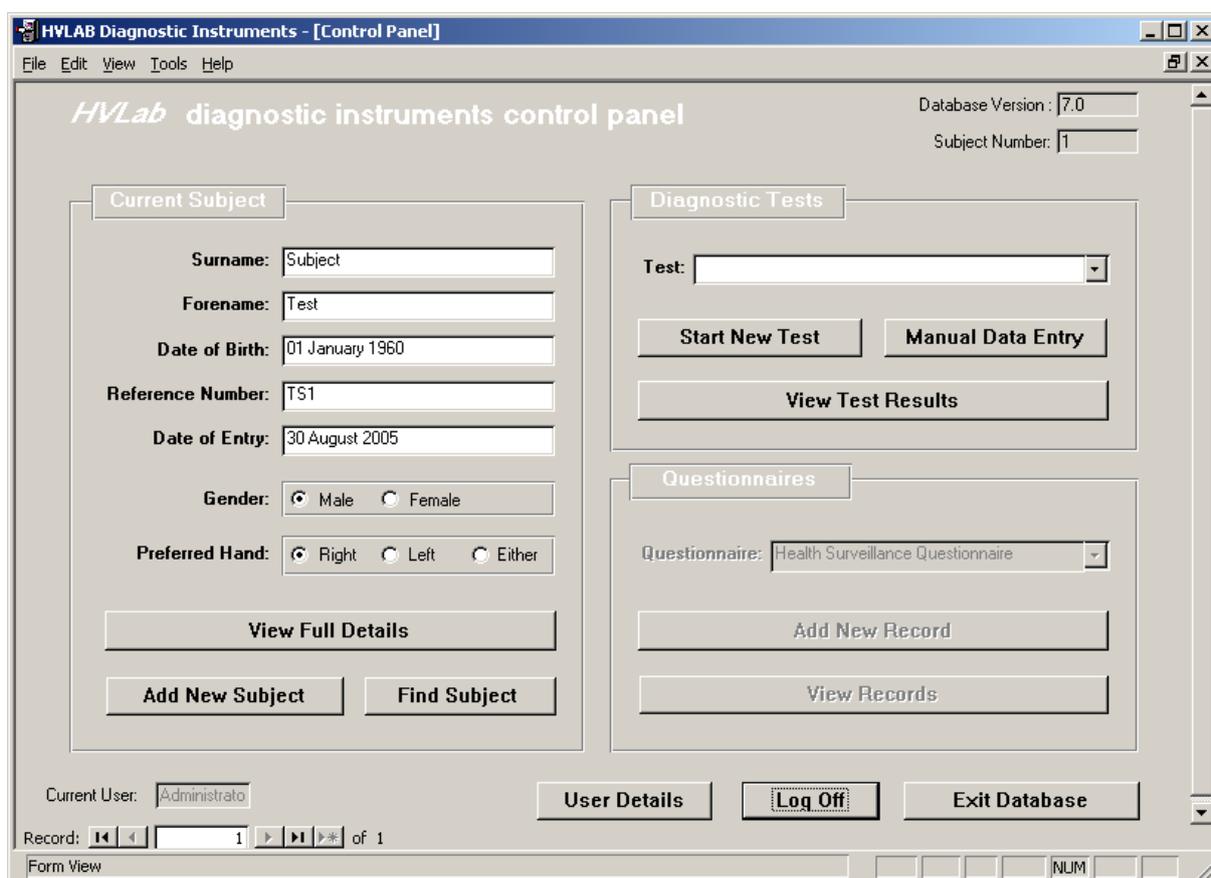


Figure 1 Control Panel window

3.1.1 Current Subject

Before running a test it is necessary to enter the details of your test subject or patient into the database by clicking on **Add New Subject** to open the **Subject Details** window (Figure 2) and filling in the fields as appropriate. If the subject has already been entered into the database, locate the subject record using the navigation buttons in the lower left corner of the **Control Panel** window, or click on **Find Subject** in the **Current Subject** section.

Personal Details Subject Number: 1

Surname: Address:

Forename:

Reference Number:

Date of Birth: NI Number:

Gender: Report submitted to:

Height (m): Weight (kg):

Preferred hand:

Marital status: Appointment date: Time:

Ethnic group: Entered by: Date:

History of changes and other information:

Form View NUM

Figure 2 Subject Details Window

3.1.2 Diagnostic Tests

The controls in the Diagnostic Tests section allow you to launch a new test, or to retrieve the results of existing tests from the test results database.

After entering or finding your subject or patient, select **Vibrotactile Thresholds** in the **Test** list box. Click on **Start New Test** to open the Vibrotactile Threshold Test window as shown in Figure 3. To retrieve the results of existing tests on the current subject, select **Vibrotactile Thresholds** and click on **View Test Results**.

3.2 Vibrotactile Threshold Test Window

The Vibrotactile Threshold Test Window is divided into four sections – Subject Details, Test Parameters, Test Details and Test Results.

3.2.1 Subject Details

The Subject Details section (see Figure 3) shows the details of the current subject, which cannot be edited here. The new test record that will be created in the vibrotactile test results database will be linked to this subject record.

Vibrotactile Threshold Test

Subject Number: 1
Test Number: 1

Subject Details

Surname: Subject
Forename: Test
Date of Birth: 01/01/1960
Reference No: TS1
Date of Entry: 30/08/2005

Test Parameters

Parameter Set Name: Default
Number of measurements: 16
Measurement duration: 45 seconds
Minimum number of test cycles: 6
Initial increment rate: 5 dB/second
Final increment rate A: 3 dB/second
Final increment rate B: 3 dB/second

Test Details

Room temperature: 21.5 °C
FST (Left): 31.7 °C
FST (Right): 32.4 °C
Background Vibration: m/s²
Test Date: 31/01/2006 16:17:36
Tester: Administrator
Data File: No file selected

Test Results

Measurement site	Freq. (Hz)	print	Threshold A (m/s ²)	Std.Dev. A (m/s ²)	Threshold B (m/s ²)	Std.Dev. B (m/s ²)	Initialise
Left index	31.5	<input type="checkbox"/>					Start
Left index	125.0	<input type="checkbox"/>					Start
Left little	31.5	<input type="checkbox"/>					Start
Left little	125.0	<input type="checkbox"/>					Start
Right index	31.5	<input type="checkbox"/>					Start
Right index	125.0	<input type="checkbox"/>					Start
Right little	31.5	<input type="checkbox"/>					Start
Right little	125.0	<input type="checkbox"/>					Start
Left index	31.5	<input type="checkbox"/>					Start
Left index	125.0	<input type="checkbox"/>					Start

Buttons: Save and Exit, Calibration, Cancel

Figure 3 Vibrotactile Threshold Test window

3.2.2 Test Parameters

The Test Parameters section (Figure 3) shows parameters of the vibrotactile measurements that will be performed in the current test. The Measurement Sites and Test Frequencies are shown in the Test Results section. These parameters may be altered from the default values by selecting different parameter sets using the **Parameter Set Name** list box. Additional parameter sets may be entered into the database and existing parameter sets may be altered or deleted by clicking the **Add New** or the **Edit/Delete** controls (see section 4.2.2.8). The **Test Parameters** section includes the following values:

3.2.2.1 Parameter Set Name

The name of the current parameter set.

3.2.2.2 Number of Measurements

The number of test measurements to be completed. A measurement refers to the threshold determined at one test site and one frequency. The default value is the maximum of 16 measurements.

3.2.2.3 Measurement Duration

This defines the minimum duration for each vibrotactile threshold measurement: the default value is 45 seconds. The range of possible durations is 30 seconds to 120 seconds in 5 second steps.

3.2.2.4 Minimum Number of Test Cycles

This is the minimum number of peaks or troughs to be completed in each threshold measurement. If this number of cycles (i.e. one peak and one trough) has not been completed within the measurement duration which it has been set to, the measurement will continue until the minimum number of cycles has been completed.

3.2.2.5 Initial Increment Rate

This is the rate of increase of the acceleration magnitude before the first button press by the subject/patient. The initial rate of increase of the magnitude of vibration is set to be higher than the final rate of increase. By doing this, the vibration magnitude quickly reaches the approximate threshold value. Since the first peak is discarded in all calculations, there are no errors introduced by this procedure. The default initial amplification rate is set at 5 dB/second. The range of initial amplification rate can be set between 1 to 6 dB/s in 1 dB/s steps.

3.2.2.6 Final increment rate A

This is the rate of increase or decrease of the acceleration magnitude between each reversal (button press). The default final amplification rate is set at 3 dB/second, with an available range of 1 to 6 dB/s in 1dB/s steps. The slower default final amplification rate (compared to the initial amplification rate) reduces the effect of subject reaction time. If the amplification rate is too slow, the subject may become bored or less than six reversals might be completed within the measurement duration.

3.2.2.7 Final increment rate B

The software allows for two rates of change of the amplitude of vibration to be present within a threshold measurement by selecting **Enable Rate B**. If two rates of change are enabled, the software will assign either rate of change to each test cycle on a random basis and calculate thresholds for both rates of change. Rate B will normally be set at twice the value of rate A (i.e. 6 dB/s). A much higher threshold in the rate B cycles indicates the possibility that a subject may be trying to cheat by responding at levels well above the subject's actual threshold.

3.2.2.8 Editing and creating new test parameters

To create a new set of test parameters, click **Add New** to open the **Vibrotactile Threshold Test Parameters** window (Figure 4). This contains three sections: **Parameter Set**, **General Settings** and **Settings for Individual Measurements**.

To define a unique parameter set, alter the values as appropriate within the General Settings section. The Settings for Individual Measurements section allows you to define measurement sites and measurement frequencies for each of the measurements. Once you have finished defining your parameters, label the parameter set in the **Parameter Set Name** field and click **Save**.

To edit the parameters in the currently selected Parameter Set, click on **Edit/Delete** in the Vibrotactile Threshold Test window. Change the desired parameter and then click **Save**.

It should be noted that any alterations to the test parameters may affect the vibrotactile thresholds obtained.

The screenshot shows a software window titled "parfrmVibrotactile : Form" with the main heading "Vibrotactile Threshold Test Parameters". The window is organized into three distinct panels:

- Parameter Set:** Contains two text input fields: "User Name" (with the value "Administrator") and "Parameter Set Name" (with the value "Default").
- Settings for Individual Measurements:** Features a table with three columns: "Measurement No.", "Measurement Site", and "Frequency (Hz)". The first row shows values "1", "Left index", and "31.5".
- General Settings:** Contains several numerical input fields with increment/decrement buttons:
 - Number of Measurements: 16
 - Measurement Duration (seconds): 45
 - Minimum Number of Test Cycles: 6
 - Initial Amplitude Increment Rate (dB/second): 5
 - Final Amplitude Increment Rate A (dB/second): 3
 - Final Amplitude Increment Rate B (dB/second): 3
 - Enable Rate B:

At the bottom of the window are three buttons: "Save", "Delete", and "Cancel".

Figure 4 Vibrotactile Threshold Test Parameters Window

3.2.3 Test details

The Test Details section (Figure 3) includes values for **Room Temperature**, **Finger Skin Temperature** (left hand and right hand) and **Background Vibration**. These should be entered before the test results are finally saved: a warning will be given by the software if values have not been entered. The values can be entered manually or will be entered automatically from a previous test. The values can also be measured and saved to the respective fields from the **Initialisation Window** (only the background vibration can be recorded when using the Tactile Vibrometer).

The **Tester** field identifies the person that performed the test (this defaults to the name of the user who is currently logged in to the database). The **Data File** field is used by the software to store the location of the data file which contains the vibrograms (see section 4.3) of the individual threshold measurements.

Check **Run as a simulation** if you wish to run a simulated test (i.e. without a subject for demonstration purposes).

3.2.4 Test Results

This section contains the vibrotactile thresholds and standard deviations for each of the test sites with their respective frequencies using the current defined parameters. The controls in this section allow you to start and repeat vibrotactile threshold measurements.

Click on one of the **Start** buttons to launch a vibrotactile threshold measurement. The fields to the left of each button show the measurement frequency that will be used and the test site to which the applicator should be applied. Clicking on **Start** opens the **Vibrotactile Threshold Measurement Window** (Figure 5), which performs the individual threshold measurement and saves the **vibrotactile thresholds** and **standard deviations** back to the database. Please read section 4.3 for instructions on how to perform a vibrotactile threshold measurement.

When all the measurements have been completed, click **Save and Exit** button in the bottom left corner of the window to save the test record to the database and return to the **Control Panel** window. Alternatively, clicking **Cancel** will return to the **Control Panel** window without saving the test results.

3.2.5 Calibration

The **Calibration button** opens the **Calibration window**. This window provides a means for monitoring push force, r.m.s. acceleration and temperature during calibration procedures. Please read section 5.3.

The calibration window also allows you to send a drive signal at different amplitudes and frequencies to the applicator.

3.3 The Vibrotactile Threshold Measurement Window

Clicking on **Start** opens the **Vibrotactile Threshold Measurement Window**. (Note: This window will only open if using the PCI-DAS1602/16 interface board. If you are using the PCL 812 interface board, a DOS-based screen will appear and measurements will begin immediately). At the top of the screen are the buttons to **Start**, **Stop**, **Cancel** or **Save** the current measurement. The name, reference number of the current subject and the date and time of test are also displayed. At the bottom of the screen are the **Site**, **Frequency (Hz)**, **Duration (s)** and **Status** of the current measurement (Figure 5). This window which displays results of the vibrotactile threshold measurements is also called a vibrogram.

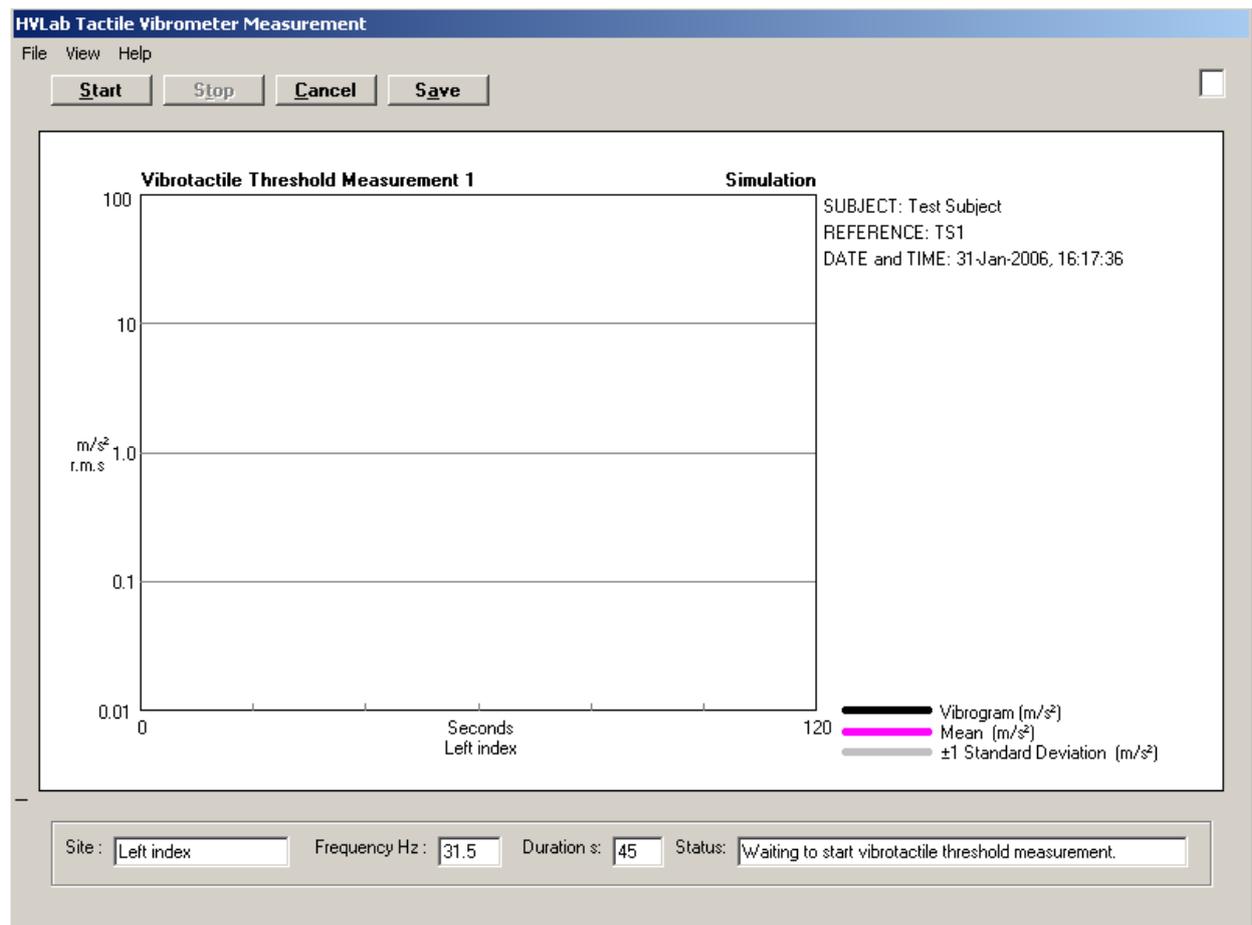


Figure 5 Vibrotactile Threshold Measurement Window

The experimental subject or patient should be given clear instructions concerning the experimental procedure before the first measurement is performed. Table 1 describes the procedure for measuring vibrotactile thresholds at the fingertip. Precautions that should be taken to ensure reliable measurements are outlined in Section 6.4 of this manual.

Click **Start** to commence the threshold measurement. The test can be interrupted at any time by clicking **Stop**. Clicking **Cancel** will be return to the **Vibrotactile Threshold Test** window and any data will be lost.

The vibrogram is displayed in real time as the response button in pressed and released.

Table 1. Instructions for experimental subjects or patients when measuring vibrotactile thresholds at the fingers

- (a) Place your finger so that the centre of the whorl on your finger-tip is situated over the centre of the probe.
- (b) Monitor the force feedback on the control box and press down gently on the probe until the meter reads 100 %. Keep the pressure on the probe so that this remains at 100% throughout the test.
- (c) Hold the response button unit in the opposite hand with the thumb over the response button.
- (d) When you feel a vibration sensation at the probe, press the response button and keep it pressed until you can no longer feel the vibration. When the vibration can no longer be felt, release the response button until the vibration sensation is felt again (i.e. when you can feel the vibration, the button should be down, when you can't feel the vibration, the button should be up).
- (e) Repeat this cycle until the experimenter informs you that the test is complete.

Once the measurement is complete, the mean threshold and standard deviation is displayed in the vibrogram (Figure 6).

Warnings are given if any of the following conditions apply:

- The peaks deviate by more than 10 dB among themselves
- The troughs deviate by more than 10 dB among themselves
- There is greater than a 10 dB variation between each pair of peaks and troughs

Click **Restart** to if you need to run the current threshold measurement again. Click **Save** to return to the **Vibrotactile Threshold Test** window. The thresholds and standard deviations will be transferred automatically to the database and displayed in the relevant fields. You will be prompted to save the complete vibrogram as a **.TVD** file: the software will automatically suggest a filename (using the reference number and date) in the Data folder, but you may choose a different filename and/or location (Figure 7).

The test results will be transferred automatically to the database and displayed in the relevant fields. The **Importing Measurement Results** dialogue is shown while the results are being transferred. This process can take several seconds. If you clicked **Save** in the measurement window please **WAIT** for the dialogue to close automatically. If you cancelled a measurement or just viewed data without making any changes, you can click the **CANCEL** button in the dialogue to remove it.

When you have completed measurements for all the test sites, click **Save and Exit** to return to the **Control Panel**. If you click **Cancel** the data will be lost as you return to the **Vibrotactile Threshold Test** window.

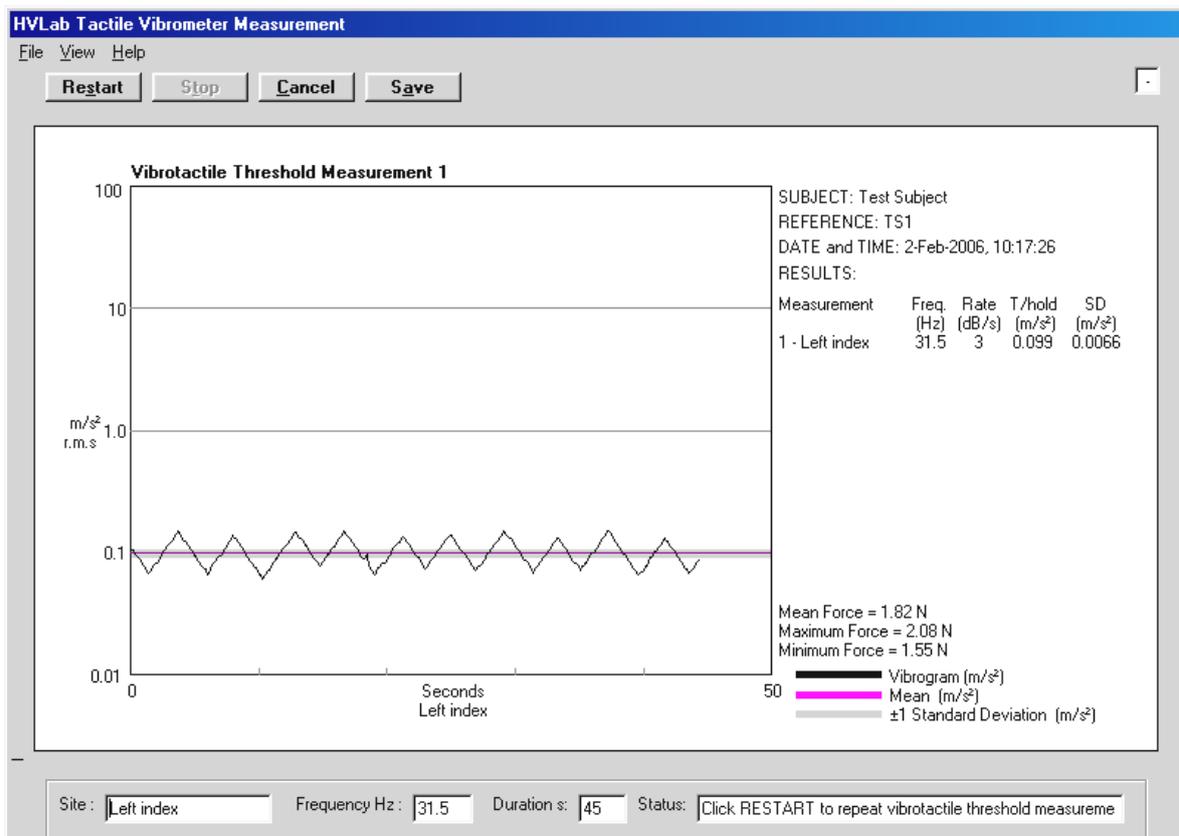


Figure 6 Results of vibrotactile threshold measurement

WARNING! Clicking Cancel will prevent any new or updated results from being saved.

3.4 Viewing Previously Collected Test Results

To view the results for a particular subject, ensure that the correct subject is displayed in the **Current Subject** section of the **Control Panel** window. Select **Vibrotactile Thresholds** from the drop down list in the **Diagnostic Tests** box and then click on **View Test Results** to display the **Vibrotactile Threshold Test** window. This is the same window that was used to launch the measurements, except that the **Start** buttons for each measurement are now replaced by **View** buttons. If there are more than one test records for the current subject, you can use the **navigation buttons** in the bottom left corner of the screen to scroll to the required record set.

Click each **View** button to display the individual vibrograms, which are saved in the **Data File** shown in the **Test Details** section. Alternatively, click **View All** to display a combined vibrogram for the current test record. It is important that the location saved in **Data File** matches the location of the .TVD data file on your PC. If it does not, a browse dialogue will allow you to browse for the data file. Alternatively, you can edit the Data File location (see section 4.7).

The vibrogram can be printed (to the default printer on your computer), or exported as a bitmap, by selecting **Print Graph** or **Export Graph** from the **File Menu**. The scaling of the vibrogram graph (i.e. the x- and y-axis limits) may be adjusted by selecting **Rescale Graph** from the View Menu. This replaces the status fields at the bottom of the window by text

controls, showing the current axis limits, which can be incremented or decremented by clicking on the associated scroll buttons.

The vibrogram data, reversal points and calculated thresholds may also be exported to a CSV file by selecting **Export Results** from the **File Menu**.

Click **Cancel** to return to the **Vibrotactile Thresholds Test** window.

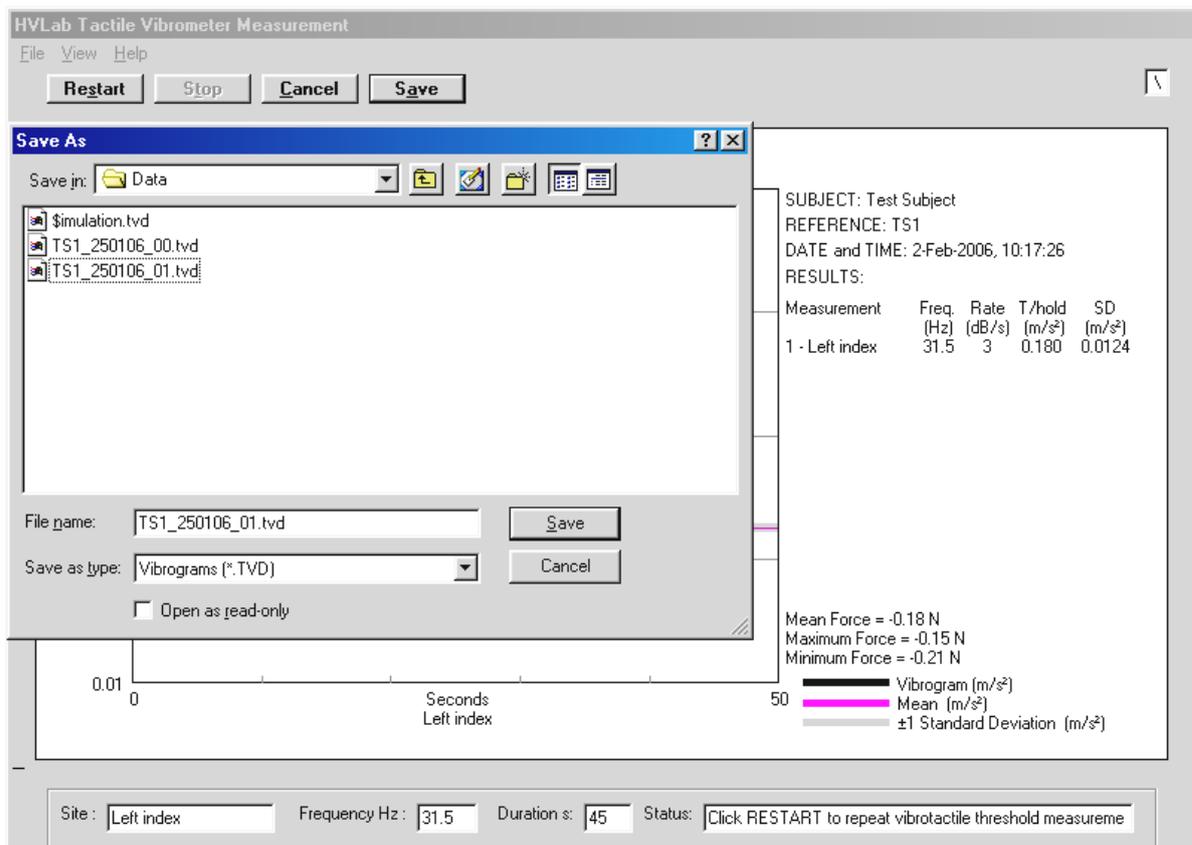


Figure 7 Dialogue for saving the vibrogram data file

3.5 Printing a Test Record

A test report of the test record can also be previewed and printed (Figure 10) from the **Vibrotactile Threshold Test** window by clicking the **Print Record** button at the bottom of the window.

The software compares the results of the thermotactile threshold test, the vibrotactile threshold test, the finger rewarming test and the finger systolic blood pressure test to normal values as according to the 'Standard diagnostic methods for assessing components of hand-arm vibration syndrome' guidelines published by the Health and Safety Executive UK. You can access this table of normal values at any time by selecting the **View Normal Values** from the **View** menu located on the menu bar at the top left-hand corner of the Control Panel window.

You can select the measurement which you would require for diagnostic comparison by checking the Print boxes next to the hot or cold threshold test of the individual measurement sites in Vibrotactile Threshold Test window. This enables you to select the appropriate threshold measurements which you will use for diagnostic comparison if you have performed and recorded repeats.

It is recommended that these **Print** boxes are checked while conducting the test or before saving a test for ease of reference if you decide to print at a much later point in time. The boxes which were selected will be saved into the test record as well.

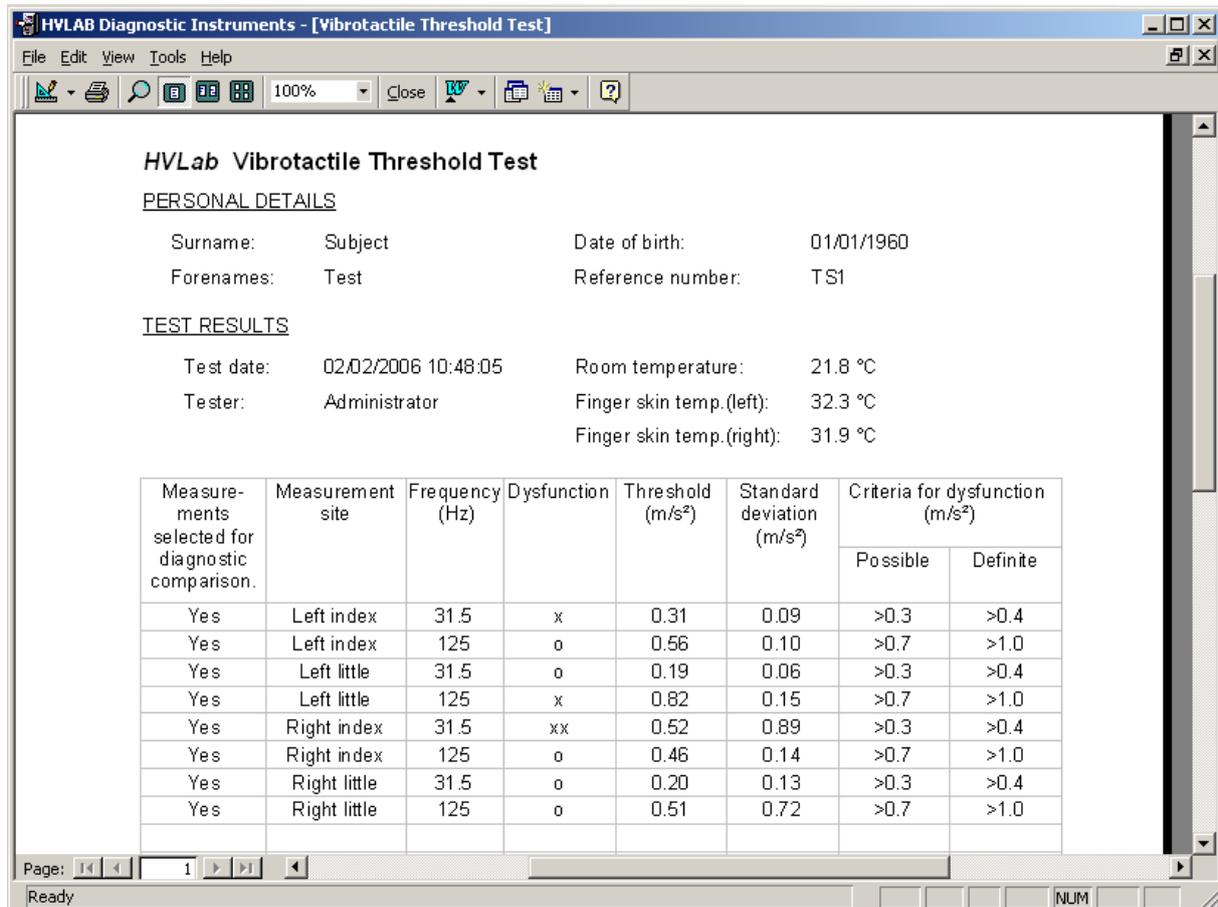


Figure 8 Diagnostic test report In Print Preview

3.6 Manually Entering Test Results

To manually enter test data for the current subject, select the required **Diagnostic Test** and click **Manual Data Entry**.

Enter your test data in the respective boxes and click **Save and Exit** when you have finished.

3.7 Editing Test Results

If you wish to modify the test results in any test record, you can do so using the following commands from the **Edit** menu located on the menu bar - **Edit Results**, **Edit Parameters**, **Edit Notes and Tester** and **Edit Data File Name**. Use these functions only when necessary.

3.7.1 Edit Results

This command allows you to edit any of the test results in the current test record. You may use this command if you have accidentally entered the wrong test results into the database during manual data entry.

3.7.2 Edit Parameters

This command allows you edit the test parameters and measurement sites in the current test record. You may use this command if you have accidentally entered the wrong test parameters or measurement sites into the database during manual data entry.

3.7.3 Edit Notes and Tester

This command allows you to edit the notes section and the name of the tester. You may use this command if you wish to add more comments to the notes section in any test record or have accidentally entered the wrong comments and name of the tester into the database during manual data entry.

3.7.4 Edit Data File Name

This command allows you to edit the location of the file where the data has been saved into. You may use this command if you have accidentally entered the wrong location of the data file during manual data entry or if you would like to update the location of a data file, which has been moved to another location on your PC, in any test record.

When you have completed editing click **Close** to save the changes.

4 Maintenance

4.1 Cleaning

The subject response button and the applicator surround and probe should be cleaned with an anti-bacterial wipe between each patient or subject.

4.2 Calibration

All *HVLab* Diagnostic Instruments are calibrated and quality controlled prior to delivery. A full calibration report is attached to this manual as Annexe 1.

The system should be re-calibrated at regular intervals (e.g. at 12 monthly intervals and whenever the equipment is moved to a new site). It is recommended that the calibration procedures are carried out by the manufacturer, or by a suitably trained person. Additionally, regular performance checks should be carried out by the user, as described in Section 5.3.

The manufacturer bears no liability for injury to any person resulting from removal of equipment casings. The manufacturer does not guarantee that calibrations carried out by any person other than one designated by the manufacturer will result in satisfactory performance of the system.

4.3 Performance checks by the user

4.3.1 *Probe surround push force*

The upward force of the probe against the finger has been set to 1 N during manufacture. The upward force can be checked or adjusted using the procedure laid out below: No liability shall be accepted by the suppliers for injury or damage resulting from removal of the cover of the *HVLab* Tactile Vibrometer.

Remove the eight screws around the side of the vibrometer unit and then lift the cover carefully, taking care not to damage the internal connecting cables.

Loosen the counterweight securing bolts.

Place the smaller of the two weights supplied with the equipment over the probe. If a force other than 1 Newton is required, place a weight corresponding to the required force on the probe.

Move the counterweight until the balance beam is horizontal.

Re-tighten the counterweight securing bolts, replace the cover of the unit, taking care not to trap any cables, and replace the securing screws.

4.3.2 *Probe position*

To ensure a constant contact surface area, the probe should always be centred in the nylon surround. The centring of the probe was checked during manufacture. Periodic checks of the gap between the probe and the nylon surround are advisable. The Tactile Vibrometer comes supplied with a 6 mm diameter probe and a 10 mm diameter surround.

To adjust the gap, the cover of the vibrometer should be removed, as described before. The probe can then be repositioned on the accelerometer as necessary. The probe is mounted using double sided adhesive tape which has been specially selected for its material properties. If more adhesive tape is required, contact your suppliers for information.

4.3.3 Finger push force

The strain gauges on the contact plate measure the downward push force of the finger. The strain gauge circuitry has adjustable sensitivity and offset. The offset control is on the control panel of the vibrometer unit, labelled ZERO ADJUST, this should be adjusted before each test. To check the offset, set the locking mechanism to the LOCK position, place the larger (2 N) weight supplied with your equipment centrally over the nylon surround and adjust the offset until the needle on the force meter points to ON. To adjust the sensitivity of the strain gauges:

Remove the eight screws around the base of the vibrometer unit and then lift the cover carefully, taking care not to damage the internal connecting cables. Place the lid on a level surface.

Set the push force meter to the "OFF" position with the ZERO ADJUST control.

Place the larger of the two supplied weights on the centre of the contact plate and adjust the sensitivity control with a small screwdriver until the push force meter needle is in the "ON" position. If a push force other than 2 Newtons is required, place a weight corresponding to the required force on the contact plate.

Remove the weight and check that the reading has returned to zero.

If necessary, repeat the operations above until the required readings are obtained.

Replace the cover of the unit, taking care not to trap any cables, and replace the securing screws.

5 Warnings and Precautions

5.1 Handling and Storage

When not in use, the Tactile Vibrometer should be switched off using the power button on the front of the control box. This will also remove power to the applicator.

Care should be given to the handling of the Tactile Vibrometer at all times, particularly the applicator. Dropping the applicator, even a short distance, may damage the applicator. If the applicator is dropped, proceed through calibration checks before the Tactile Vibrometer is used (see section 4).

The Tactile Vibrometer can be left connected to the computer whilst not in use. It is preferred that the connection between the adapter box and the PC is disturbed as little as possible as this may cause damage to the connector.

Care should be given not to exert large forces (i.e. more than 3N) on the probe or surround. This may damage the suspension mechanisms inside the applicator.

5.2 Obtaining reliable measurements

In order to obtain repeatable measurements of vibrotactile thresholds, attention should be given to various factors, these include:

5.2.1 *Finger skin temperature*

Finger skin temperatures at the measurement locations should not be below 22° C.

5.2.2 *Previous exposures to vibration*

Exposure to vibration immediately prior to measurement of vibrotactile thresholds might result in a temporary threshold shift. Any temporary threshold shift should be allowed to recover before measurement of vibrotactile thresholds.

5.2.3 *Previous exposure to extremes of temperature*

The subject should be allowed to acclimatise to the temperature of the room for a suitable amount of time before testing to ensure thermal equilibrium.

5.2.4 *Auditory cues*

When testing at frequencies above 125 Hz, an audible sound may be produced by the applicator before the vibration is felt. Precautions should be taken to ensure that the subject is not presented with auditory cues. Suitable precautionary measures include the use of ear defenders, ear plugs or masking tones for the duration of each measurement.

5.2.5 *Finger contact*

For measurements on the finger, it is recommended that thresholds be obtained for the volar surface of the distal phalanx of the fingers with the probe located at the centre of the whorl.

5.2.6 *Acceleration waveform*

The probe acceleration should be monitored from time to time to ensure that the waveform is not distorted or noisy. To do this, an oscilloscope should be connected to the BNC connector provided on the rear panel of the instrument. During a test, the signal should be observed as a clean sine wave at the test frequency.

5.2.7 Instructions to subjects

All subjects should be given a set of written instructions. This is done to ensure that nothing is omitted when preparing the subject for the test and that the psychophysical response is not affected by giving subjects differing instructions. Table 1 (see section 4.3) shows a sample set of instructions which may be copied for use in combination with the Tactile Vibrometer.

5.2.8 Location of the applicator

Position the applicator unit on a firm, level surface that is isolated from the surface supporting the controlling computer (which contains cooling fans) or any other sources of vibration. It is desirable to avoid using the device in rooms with suspended floors, since walking over such floors can generate perceptible vibration. The apparatus should be placed on a firm table for the same reason.

6 Spares and ancillary services

The following accessories are available from the manufacturer. Please refer to the contact details at the beginning of this guide. If you wish to replace or have spares of a specific component, please contact us and we will endeavour to help you.

Subject Response Button

K-type thermocouple

Different diameter applicator probes and matching surrounds

Accelerometer extension cable and mount for additional accelerometer (required for calibrating the vibration measurements)

Distribution Box to allow a complete suite of *HVLab* instruments to be controlled by a single computer and interface board

We can also provide training, calibration and auditing of the operation of all diagnostic instruments. Please contact the manufacturer for a quotation.

7 Troubleshooting guide

Problem	Possible Cause	Solution
No Power	The AC power lead has become disconnected from the control box There is no mains power supply to the control box	Check that the AC power lead is connected to the control box and that the power supply is connected to the mains.
Pressing the subject response button does not reduce the vibration	The response button is not connected The response buttons is faulty	Check that the response button is connected to the front of the control box Check that the LED labelled 'Response' lights when the button is depressed Contact manufacturer if no light is seen, although button is connected
Temperature display does not show any numbers	K-type thermocouple is not connected K-type thermocouple is faulty	Check that you have connected a k-type thermocouple to the front of the control box Replace with a spare thermocouple if necessary
The vibrogram displayed appears distorted, broken or messy	There is a high level of background noise The accelerometer is not connected	Check the background noise without excitation of the applicator is $<0.01 \text{ ms}^{-2} \text{ r.m.s}$ Check that there are no obvious sources of external vibration in close proximity to the applicator. Check that the applicator is being used on a stable surface. Check that the accelerometer cable on the inside of the applicator is connected.
I get a message saying "A to D interface card not found"	The settings are incorrect on the DAS 1602-16 card.	Ensure that the card is set to 16 open ended channels within the INSTACAL software.

If any of the above suggestions do not solve your problem, please contact the manufacturer by telephone on +44 (0) 2380 592277.

Annexe A Interface board installation

A PC which is to be connected to one or more *HVLab* Diagnostic Instruments must first be installed with either a PCL 812 or a PCI-DAS1602/16 interface board. Follow the instructions for installation of either interface board depending on the type which you have.

A.1 PCI-DAS1602/16 Interface board

- (i) Install the **InstaCal** software from the CD supplied with the PCI-DAS 1602/16 analogue interface board, then fit the board into a free PCI slot in your PC in accordance with the board manufacturer's instructions.
- (ii) After installing the board, run the **InstaCal** programme to self-calibrate and configure the analogue inputs and outputs. The DAS1602/16 board number must be **Bd#0** (i.e. board zero). If you find that another board (e.g. a Demo Board) is board zero, then remove all boards by clicking on **Install/Remove All**. Then reinstall the DAS1602/16 as the first (number zero) board.
- (iii) Make sure your DAS 1602/16 is configured for 16 Single Ended Analogue Input channels: click on the DAS1602/16 board to highlight it, then click on **Install/Configure** and make sure **Number of Channels = 16 Single Ended**.
- (iv) After installing and configuring your DAS 1602/16 board, you will need to calibrate the analogue inputs and outputs. Make sure nothing else is connected to your board during the calibration. Click on your DAS1602/16 board to highlight it, then click on the **A/D** button to self-calibrate the analogue inputs. Click on OK when calibration is complete. Click on the **D/A** button to calibrate the analogue outputs. Click on OK when calibration is complete. This should not need to be repeated unless the board is replaced or moved.

A.2 PCL 812 Interface board

- (i) The PCL 812 board can only be used with Windows 98.
- (ii) The PCL 812 board fits into a free ISA slot in your PC. No additional software is required to operate this board. The addresses and other board settings are controlled by switches and headers on the PCB: these should all be left in the factory-set default positions, as described in the PCL 812 user manual.
- (iii) Connect the 20-way ribbon cable extensions to the corresponding connectors on the PCL 812 board. Make sure that the label on each cable end corresponds to the label on the corresponding board connector. Please refer to the respective *HVLab* Diagnostic Instruments manuals for the correct cable labels.
- (iv) Open **Device Manager** from **Start/Control Panel/System**, click the **Properties** button and select **Input/output (I/O)**. Check that no devices are using addresses in the range **0220-022F**. If there is a device using these addresses, select it from the list of devices in the **Device manger** window, click on **Properties** and **Resources**, then change the conflicting address range to the next available values. Finally, click on the **Reserve resources** in the **Properties** tab and reserve the address range **0220-022F**.

Annexe B Installing and setting up the software

B.1 Software installation options

Before performing the installation of the software, decide whether you want to perform:

A **new** installation – this means that the PC has never been installed with the *HVLab* Diagnostic Instruments Manager software. This is explained in Section B.2.

An installation of the software **parallel** to a previous version already installed on the PC – this means that the PC has previously been installed with the *HVLab* Diagnostic Instruments Manager software and you would now like to install either a new version of the software or you would like to start a new database with the same version of the software. This is explained in Section B.3.

An installation on a **distributed network** – this means that you would be able to perform different tests and view the test results with the same database using separate computers which work over a network. This is explained in Section B.4.

B.2 Performing a new installation

- (i) Ensure that MS ACCESS 2000 (or a later version of ACCESS) is **not** installed on your computer. Close any Windows programmes that are running and put the installation CD into your CD-ROM drive - this is assumed to be drive *D:* (If your CD-ROM drive is not drive *D:* or if you are installing from a network drive, then replace *D:* in the following with the drive letter corresponding to your installation drive).

- (ii) Select *Run* from the Microsoft Start Menu: this will open the **Run** dialogue window. Click on the **Browse** button.

If you have installed the PCL 812 board select ***D:\HVLab_PCL812\Setup.Exe*** and then click on **Open**.

If you have installed the PCI-DAS1602/16 interface board select ***D:\HVLab_DAS1602\Setup.Exe*** and then click on **Open**.

- (iii) When prompted, confirm installation to ***C:\HVLwin***, and choose **Typical** installation.

Note: If any other programs are running in the background the following Message may appear during the installation process...

“Setup could not write to the file XYZ.

This file is currently being used by another application

Close any open applications”

If this message does appear, click **Ignore**. This should not affect your installation.

- (iv) *Setup* may leave open an MSDOS dialogue named “Finished-HTVPIF”. Click the close button in the top right corner of the dialogue.
- (v) If prompted, allow *Setup* to restart your computer to complete the installation.

- (vi) To be able to access the *HELP* documents from the *HVLab* software you will need to install Acrobat Reader (version 6.0 or above) on your computer. If you do not already have it, you can install Acrobat Reader by running **D:\Acrobat Reader\AdbeRdr60_enu_full.exe** from the 'Run' dialogue or Windows Explorer.
- (vii) Start the *HVLab* software by selecting **Diagnostic Instruments Manager** from the **Start/Programs/HVLab Diagnostic Instruments** menu. Alternatively, you can copy the shortcut to the desktop. You will be required to enter a valid User ID and Password: the default User ID is "Admin" with password "hvlab". Additional users can be added or deleted after the software has been successfully set up (see the Diagnostic Instruments Database user manual for more details).
- (viii) The first time that the software is run, the location of all the software components will be automatically detected and displayed in the **Database Components** window. The software should have detected the correct locations for all the components in the **(InstPath)** and **(InstPath)\Data** where **(InstPath)** is the folder into which the software was installed, which defaults to **C:\HVLwin** (see the Diagnostic Instruments Database user manual for more details).
- (ix) Scroll down the **Database Components** window until you see the **Select Test Properties** box and make sure that the boxes in the **Enabled** column are ticked for all the tests which you want to be available on your computer. Tests for which you do not have the necessary instrument hardware connected can be run in **Simulation** mode (check the boxes for these tests in the **Simulation** column). Make sure that the board type selected for each test corresponds to the interface board that is installed in your computer and connected to the respective instrument (see the Diagnostic Instruments Database user manual for more details).
- (x) **Note:** If you are using the *HVLab Tactile Vibrometer* with a DAS1602 interface board you will need to
- change the **Hardware** setting for Vibrotactile **Thresholds** in the *Select Test Properties* box to **Revision 1**;
 - replace the file **(InstPath)\VibroDefault.cal** with **D:\Support for Tactile Vibrometer\VibroDefault.cal** (i.e. from the installation CD)
- (xi) When you are satisfied that all the components, tests and boards have been specified correctly, click on '**Save**'. This will link the database program to the tables and open the main **Control Panel** window.
- (xii) Click on '**Add User**' and enter a name, User ID and Password for the principal user of the system (see the Diagnostic Instruments Database user manual for more details). Make sure that you choose '**Admin**' for the user group. Each time that you run the software you will need to log on using a valid User ID and Password before you can access the *Control Panel*. The default user (User ID "Admin" with password "hvlab") can be deleted after you have entered and tested User IDs and Passwords for all of your operators.

B.3 Performing a parallel installation

Note: If you are using the old **HVLab Tactile Vibrometer**, which uses the PCL812 interface board, you **cannot** perform a parallel installation on the same PC.

You can choose to replace the old installation with a new version, but by doing this, you will not be able to access the old database conveniently on the same PC.

*You should first make a back-up of the old database, by copying the whole **HVLwin** folder on the C: drive onto a separate storage location.*

*When you are confident that the **HVLwin** folder has been safely backed-up, delete the **HVLwin** folder from the C: drive and follow the instructions for '**Performing a new installation**'.*

- (i) Ensure that MS ACCESS 2000 (or a later version of ACCESS) is **not** installed on your computer. Close any Windows programmes that are running and put the installation CD into your CD-ROM drive - this is assumed to be drive *D:* (If your CD-ROM drive is not drive *D:* or if you are installing from a network drive, then replace *D:* in the following with the drive letter corresponding to your installation drive).
- (ii) Select *Run* from the Microsoft Start Menu: this will open the **Run** dialogue window. Click on the **Browse** button.

If you have installed the PCL 812 board select **D:\HVLab_PCL812\Setup.Exe** and then click on **Open**.

If you have installed the PCI-DAS1602/16 interface board select **D:\HVLab_DAS1602\Setup.Exe** and then click on **Open**.
- (iii) When prompted, click on **Change Folder** to install the *HVLab* Diagnostic Instruments software into a different folder which does not exist on the C: drive. Enter the destination folder to your preference. Confirm that you would want to create the new folder for installation and choose **Typical** installation.
- (iv) *Setup* may leave open an MSDOS dialogue named "Finished-HTVPIF". Click the close button in the top right corner of the dialogue.
- (v) If prompted, allow *Setup* to restart your computer to complete the installation.

Note: If any other programs are running in the background the following Message may appear during the installation process...

"Setup could not write to the file XYZ.

This file is currently being used by another application

Close any open applications"

If this message does appear, click **Ignore**. This should not affect your installation.

- (vi) Note that if you are performing a parallel installation of the same version of the software, the setup programme might prompt you to perform a reinstallation of the software. To get around this, exit the setup and enter it again. You will now be able perform the parallel installation without a problem.

- (vii) To be able to access the *HELP* documents from the *HVLab* software you will need to install Acrobat Reader (version 6.0 or above) on your computer. If you do not already have it, you can install Acrobat Reader by running **D:\Acrobat Reader\AdbeRdr60_enu_full.exe** from the 'Run' dialogue or Windows Explorer.
- (viii) Start the *HVLab* software by selecting **Diagnostic Instruments Manager** from the **Start/Programs/HVLab Diagnostic Instruments** menu. Alternatively, you can copy the shortcut to the desktop. You will be required to enter a valid User ID and Password: the default User ID is "Admin" with password "hvlab". Additional users can be added or deleted after the software has been successfully set up (see the Diagnostic Instruments Database user manual for more details).
- (ix) The first time that the software is run, the location of all the software components will be automatically detected and displayed in the **Database Components** window. The software should have detected the correct locations for all the components in the **(InstPath)** and **(InstPath)\Data** where **(InstPath)** is the folder into which the software was installed (see the Diagnostic Instruments Database user manual for more details).
- (x) Scroll down the **Database Components** window until you see the **Select Test Properties** box and make sure that the boxes in the **Enabled** column are ticked for all the tests which you want to be available on your computer. Tests for which you do not have the necessary instrument hardware connected can be run in **Simulation** mode (check the boxes for these tests in the **Simulation** column). Make sure that the board type selected for each test corresponds to the interface board that is installed in your computer and connected to the respective instrument (see the Diagnostic Instruments Database user manual for more details).
- (xi) **Note:** If you are using the *HVLab Tactile Vibrometer* with a DAS1602 interface board you will need to
- change the **Hardware** setting for Vibrotactile **Thresholds** in the *Select Test Properties* box to **Revision 1**;
 - replace the file **InstPath)\VibroDefault.cal** with **D:\Support for Tactile Vibrometer\VibroDefault.cal** (i.e. from the installation CD)
- (xii) When you are satisfied that all the components, tests and boards have been specified correctly, click on '**Save**'. This will link the database program to the tables and open the main **Control Panel** window.
- (xiii) Click on '**Add User**' and enter a name, User ID and Password for the principal user of the system (see the Diagnostic Instruments Database user manual for more details). Make sure that you choose '**Admin**' for the user group. Each time that you run the software you will need to log on using a valid User ID and Password before you can access the *Control Panel*. The default user (User ID "Admin" with password "hvlab") can be deleted after you have entered and tested User IDs and Passwords for all of your operators.

B.4 Performing an installation over a distributed network

- (i) Please make sure that all the computers do not have a previous installation of the *HVLab* Diagnostic Instruments Manager software in them. If they do, you would need to follow the instructions for '**performing a parallel installation**', otherwise please follow the instructions for '**performing a new installation**'.
- (ii) Before launching the database on any of the computers it is necessary to create a common database table on the network. On one computer only, locate the **Data** folder in the folder into which the *HVLab* Diagnostic Instruments Manager software was just installed. Copy this folder to a location on the network that can be accessed by all the test computers. Please note that all the computers which need to use the database over a network must have full-access rights to this location on the network.
- (iii) Start the *HVLab* software on each computer by selecting **Diagnostic Instruments Manager** from the **Start/Programs/HVLab Diagnostic Instruments** menu. Alternatively, you can copy the shortcut to the desktop. You will be required to enter a valid User ID and Password: the default User ID is "**Admin**" with password "**hvlab**". Additional users can be added or deleted after the software has been successfully set up (see the Diagnostic Instruments Database user manual for more details).
- (iv) The first time that the software is launched on each computer, the location of all the software components will be automatically detected and displayed in the **Database Components** window. The default location for the file containing the data tables - *HVLab_di_tables.mdb* - is **(InstPath)\Data** where **(InstPath)** is the folder into which the software was installed, which defaults to **C:\HVLwin**. Use the browse button to the right of the displayed data path to find the copy of the data tables that have been moved to the network (see ii, above). The five data folders for the individual test data should also be relocated to the data folder on the network (see the Diagnostic Instruments Database user manual for more details).
- (v) Scroll down the **Database Components** window until you see the **Select Test Properties** box and make sure that the boxes in the **Enabled** column are ticked for all the tests which you want to be available on this computer. Tests for which you do not have the necessary instrument hardware connected can be run in **Simulation** mode (check the boxes for these tests in the **Simulation** column). Make sure that the board type selected for each test corresponds to the interface board that is installed in your computer and connected to the respective instrument (see the Diagnostic Instruments Database user manual for more details).
- (vi) When you are satisfied that all the components, tests and boards have been specified correctly, click on '**Save**'. This will link the database program to the tables and open the main **Control Panel** window.
- (vii) Click on '**Add User**' and enter a name, User ID and Password for the principal user of the system (see the Diagnostic Instruments Database user manual for more details). Make sure that you choose '**Admin**' for the user group. Each time that you run the software you will need to log on using a valid User ID and Password before you can access the *Control Panel*. The default user (User ID "Admin" with password "hvlab") can be deleted after you have entered and tested User IDs and Passwords for all of your operators.