pundit lab

Operating Instructions

Pundit Lab / Pundit Lab+ Ultrasonic Instrument

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... more than 50 years of know-how you can measure!

Table of Contents

Standards and Guidelines

Pundit Lab complies with the following standards: EN 12504-4 (Europe), ASTM C597-02 (North America), BS 1881 Part 203 (UK), ISO1920-7:2004 (International), IS13311 (India), CECS21 (China)

CE

1. Safety and Liability

1.1. Safety and usage precautions

This manual contains important information on the safety, use and maintenance of the Pundit Lab. Read through the manual carefully before the first use of the instrument. Keep the manual in a safe place for future reference.

1.2. Liability and warranty

Proceq's "General Terms and Conditions of Sale and Delivery" apply in all cases. Warranty and liability claims arising from personal injury and damage to property cannot be upheld if they are due to one or more of the following causes:
- Failure to use the instrument in accordance with its designated use as described in this manual.
- Incorrect performance check for operation and maintenance of the instrument and its components.
- Failure to adhere to the sections of the manual dealing with the performance check, operation and maintenance of the instrument and its components.
- Unauthorized structural modifications to the instrument and its components.
- Serious damage resulting from the effects of foreign bodies, accidents, vandalism and force majeure.

All information contained in this documentation is presented in good faith and believed to be correct. Proceq SA makes no warranties and excludes all liability as to the completeness and/or accuracy of the information.

1.3. Safety instructions

The instrument is not allowed to be operated by children or anyone under the influence of alcohol, drugs or pharmaceutical preparations. Anyone who is not familiar with this manual must be supervised when using the instrument.

1.4. Labelling

The following icons are used in conjunction with all important safety notes used in this manual.

> **i**   **Note:**
> This symbol indicates important information.

1.5. Correct Usage

- The instrument is only to be used for its designated purpose as describe herein.
- Replace faulty components only with original replacement parts from Proceq.
- Accessories should only be installed or connected to the instrument if they are expressly authorized by Proceq. If other accessories are installed or connected to the instrument then Proceq will accept no liability and the product guarantee is forfeit.

2. Getting started

Rear Panel
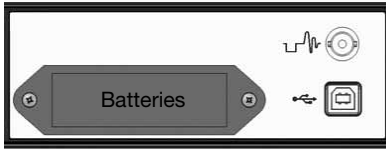
Connectors for:
Oscilloscope

USB – PC / Power Supply

The Pundit Lab can be powered by batteries, by the mains or by the USB connection to a PC.

Front Panel

The soft keys are context sensitive. The display icon shows the active function.

The lower right-hand key is for Power ON/OFF and also to "Cancel" a setting and return to the previous menu.

The navigation key is for scrolling through menus and for setting variable parameters.

Transducer Connection
Connect the transducers to the front of the display unit using the BNC cables. If cables of different lengths are used, the longer cable should be connected to the transmitter.

> **Note:** To avoid the possibility of electrical shock, the transducers must be connected before switching on and disconnected only after switching off.

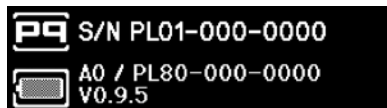Basic Measurement   System Settings

Compound Measurement   Information

Power ON
Press and hold the lower right-hand key for 3 seconds. The main menu and the type "Pundit Lab" or "Pundit Lab⁺" is displayed.

Clicking on the "Information" soft key brings up important device information.

Serial number

Battery status or USB connection

Hardware version
Firmware version

Power Management – Power OFF
When operating on battery power the instrument goes into standby mode after 5 minutes of inactivity. After 30 minutes it shuts down completely. When powered by the USB connection, the display shuts down after 1 hour of inactivity. Press the lower right hand key (Power ON/OFF, Cancel) to recover from standby mode. To power off, press and hold the lower right-hand key for 3 seconds.

Zeroing the Pundit Lab
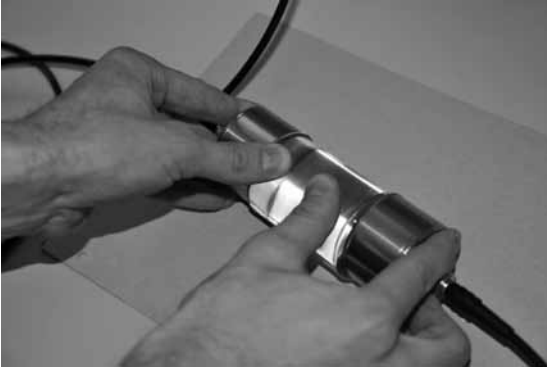
The Pundit Lab should be zeroed using the calibration rod on a regular basis and in particular if the transducer frequency is changed or if the cables are changed. The expected calibration value (µs) is marked on the calibration rod.

Couple the transducers to the calibration rod by applying couplant to the transducers and both ends of the rod and pressing firmly together as shown.

i **Note:** When zeroing the exponential transducers the dedicated calibration rod (325 40 174) should be used.
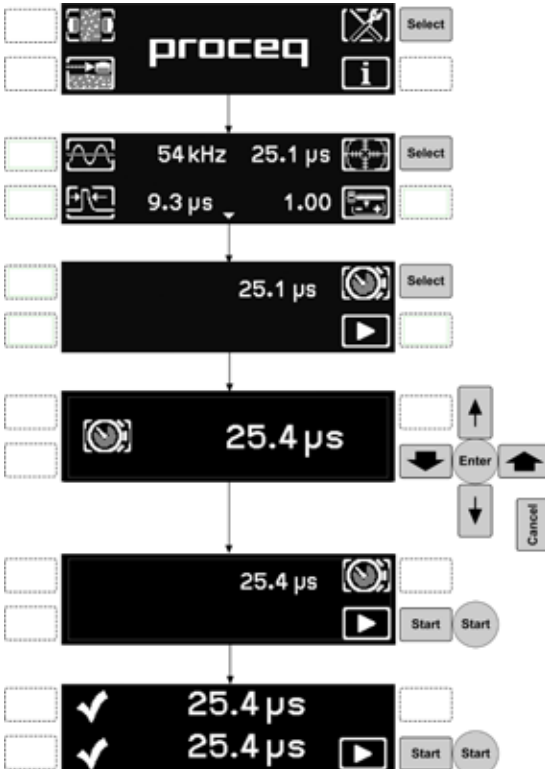
Select System Settings
(See chapter 3 for more info)

Check Tx/Rx matches transducer frequency. Pulse width requires no adjustment.
Correction factor set to 1.0.
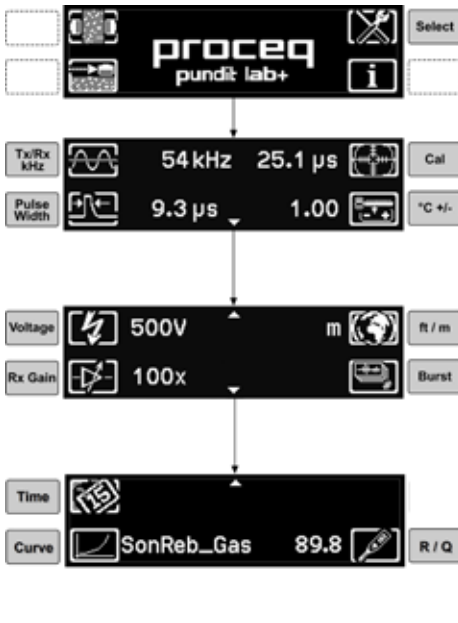Select Calibration.

If necessary, select to enter the transit time as marked on the calibration rod.

Variable parameter; set as follows:
Up/down keys - fine adjustment
Left/right keys - coarse adjustment.
Center key - enters the value and returns to the previous menu.
Cancel key - cancels the input and returns to the previous menu.

Press "Start" to begin the calibration sequence.

The final display shows the expected transit time and below it the measured transit time. This should match the value on the calibration rod.

3. System Settings

Select System Settings

Set:
- Transducer frequency
- Pulse width
- Calibration setting
- Correction factor

Or scroll to next screen
Set:
- Excitation voltage
- Receiver gain
- Units (metric/imperial)
  (Pundit Lab+ only:
  Compressive strength unit)
- Continuous or burst
  transmission

Pundit Lab+ only
Set:
Date and time
Compressive strength curve (Rebound value for SONREB method)

Parameter		Presets (Click on soft key to scroll through)	Variable (Set with navigation key; see 2.1)
Tx / Rx Frequency (kHz)		24, 37, 54, 82, 150, 200, 220, 250, 500	-
Pulse width		Automatic	1-100 µs
Calibration (See 2.1)		-	1-110 µs
Correction factor		-	0.07 – 1.3
Excitation voltage (V)		125, 250, 350, 500, AUTO	-
Rx Gain	Pundit Lab Pundit Lab+	1x, 10x, 100x, AUTO 1x, 2x, 5x, 10x, 20x, 50x, 100x, 200x, 500x, 1000x, AUTO	-
Units	Pundit Lab Pundit Lab+	ft / m ft / m, MPa, N/mm2, psi, kg/cm2	-
Transmission pulse		Continuous / burst	-
Date and time (Pundit Lab+)			Set time stamp.
Compressive strength curve (Pundit Lab+)		Curves defined in PunditLink.	Enter a rebound value for SONREB curves.

Automatic Gain and Voltage Setting

The excitation voltage and the receiver gain can both be set to automatic. In this mode the Pundit Lab finds the optimum combination of the two parameters for a stable measurement.

Rx Gain 200x, 500x, 1000x

This feature is available in Pundit Lab+ only and replaces the need for an external amplifier (325 40 059) when using long cables or exponential transducers. When such high gain stages are selected it is highly recommended to use manual triggering with the waveform display.

Pulse Width

The pulse width is automatically set to the optimum value for the selected transducer frequency and typically requires no adjustment. For certain applications, it may however be adjusted if desired. (Refer to ASTM D 2845 - Standard Test Method for Laboratory Determination of Pulse Velocities and Ultrasonic Elastic Constants of Rock.)

It also allows non-standard transducers up to 500 kHz to be used with Pundit Lab:
Pulse width "p" in microseconds (µs) to be entered here is calculated from the formula
$p = 1'000/(2*f)$, where f = transducer frequency in kHz
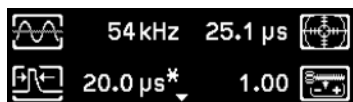
 If a non standard value is set manually it is indicated by an asterisk.

Continuous/Burst Transmission

 Continuous transmission continues transmitting until the "Stop" button is pressed.

 Burst transmission sends out packets of pulses until a stable reading is obtained then stops automatically.

Correction Factor

Pulse velocity measurements are affected by several factors. These are well described in BS 1881 : Part 203 and it is recommended that the user refers to this document. Two key factors are the moisture content of the concrete and the temperature. The table below shows the correction factor that should be keyed in based on the recommendations made in the above standard.
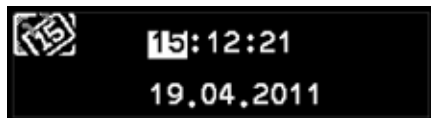
Temperature	Dry concrete	Wet concrete
10°C – 30°C	1.0 (No correction)	1.0 (No correction)
60°C	1.05	1.04
40°C	1.02	1.02
0°C	0.99	0.99
-4°C	0.98	0.92

Units (Pundit Lab+ only)
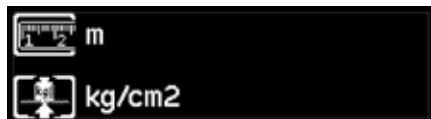
 Selecting units opens a second screen where the user may select a compressive strength unit in addition to the imperial or metric units.

**Date and Time (Pundit Lab+ only)**

 Used to provide measurements with a time stamp.
Use the left and right keys to move between settings. Use the up and down keys to adjust the settings. Press enter to save, or cancel to return without saving.

4. Viewing the Waveform

While carrying out the measurements described in the following chapter it is possible to view the received waveform. Pundit Lab offers three possibilities to look at the waveform.
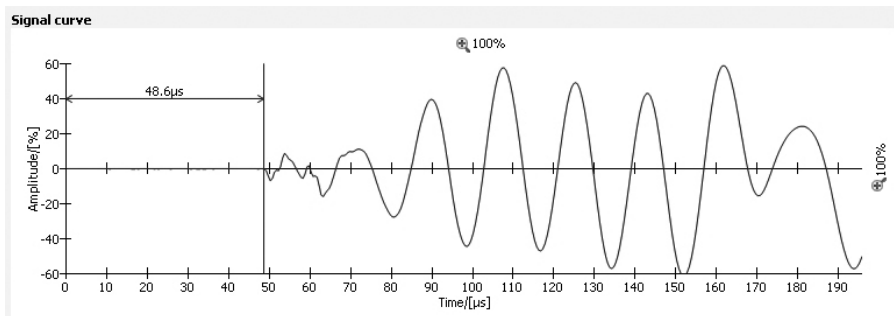
Oscilloscope

Connect an oscilloscope to the connector on the rear panel. A typical waveform will look like this:
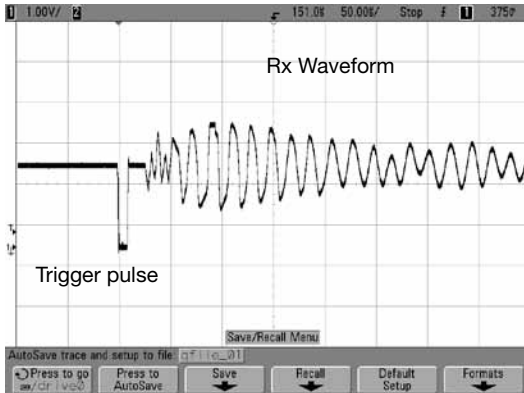
Both the trigger pulse and the received waveform are displayed.

Pundit Link - PC

The waveform may also be viewed on a PC or Laptop connected via the USB port. Please refer to the Pundit Link operating instructions for details (chapter 9).

On the instrument

The waveform may be directly viewed on the instrument. See next chapter for operating details.

5. Measuring with Pundit Lab

The Pundit Lab can be used for several applications including the following:

- Pulse velocity measurement
- Path length measurement
- Uniformity assessment
- Surface velocity measurement
- Crack depth measurement
- Estimating the dynamic elastic modulus of samples (with the shear wave transducers)
- Pundit Lab[+] only. Estimating compressive strength using pulse velocity alone or in combination with a rebound hammer

Transducer arrangement
Three transducer arrangements are commonly used.

Direct   Semi-direct   Indirect or surface
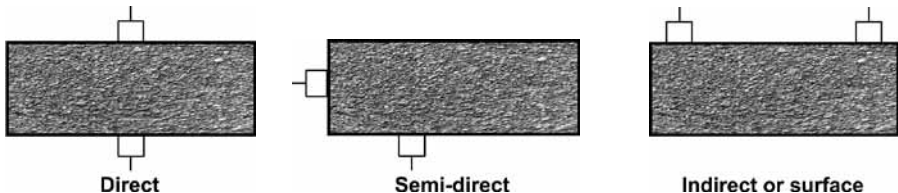
Wherever possible use the direct arrangement as this ensures the maximum signal transmission between the transducers. The semi-direct arrangement is less sensitive than the direct, but more sensitive than the indirect arrangement. The path length is the distance between the centers of each transducer.

The indirect method is particularly useful for determining crack depth, surface quality or in the case when only one surface is accessible.

5.1. Preparation

Basic preparations are common to each application. The distance (path length) between the transducers should be measured as accurately as possible. It is very important to ensure adequate acoustic coupling of the transducers to the surface under test. A thin layer of couplant should be applied to the transducer and the test surface. In some cases it may be necessary to prepare the surface by smoothing it.

For compound measurements and uniformity testing a test grid should be drawn out on the surface.
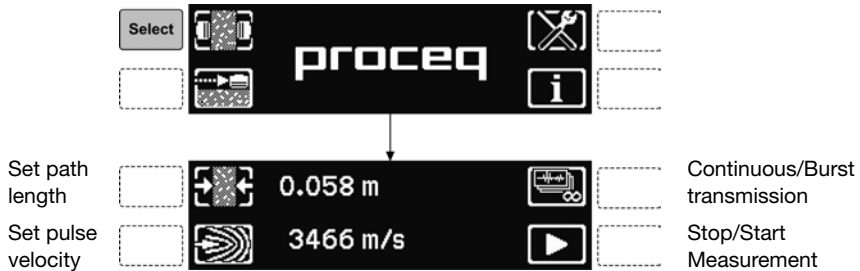
Rebars affect the ultrasonic measurements as the signal will travel faster through the rebar than through the concrete. The location of rebars should be determined using a rebar locator such as Proceq's Profoscope and ultrasonic tests should be positioned so as to avoid them. BS 1881 Part 203 gives information on the effect of rebars on the expected results.
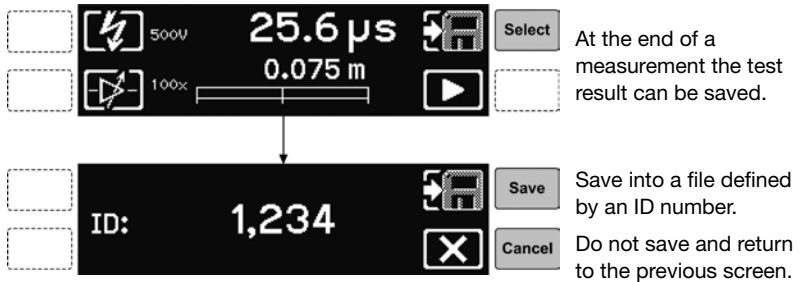
The standard measuring procedure is:
- Apply the couplant.
- Position the transducers.
- Perform the measurement.
- Reposition the transducers (compound measurements only).
- Save the result.

5.2. Basic Measurements

Basic measurements consist of a single measurement without the need to reposition the transducers. There are two basic measurements, depending on which parameter is known, either the path length or the pulse velocity.
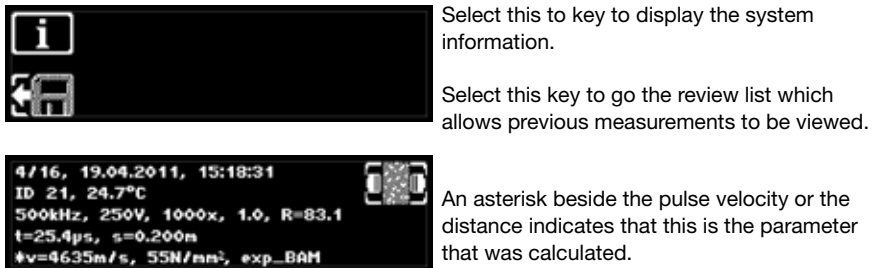

Set path length	Continuous/Burst transmission
Set pulse velocity	Stop/Start Measurement

Saving Measurements

At the end of a measurement the test result can be saved.

Save into a file defined by an ID number.

Do not save and return to the previous screen.

Review List (Pundit Lab⁺ only)

From the main menu, clicking on the system information key (See getting started) brings up a sub menu:

Select this to key to display the system information.

Select this key to go the review list which allows previous measurements to be viewed.

An asterisk beside the pulse velocity or the distance indicates that this is the parameter that was calculated.

1st row : Measurement (e.g. 4 of 16) / Time stamp
2nd row: Measurement ID / Temperature
3rd row: Frequency / Voltage / Gain / Correction factor / Rebound value (SONREB only)
4th row: Transmission time / Distance
5th row: Pulse velocity / Compressive strength / Conversion curve

5.3. Basic Measurement – Pulse Velocity

In order to measure the pulse velocity it is necessary to measure the path length between the two transducers.
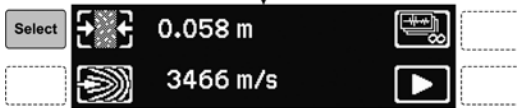
Select proceq	Select "Basic Measurements"
Select 0.058 m 3466 m/s	Select parameter setting "path length"
0.200 m	Enter the path length
0.200 m 0 m/s **Start**	Start the measurement
25.6 µs 3466 m/s **Stop**	The display shows: - Transmission time - Measured pulse velocity - Received signal level * Stop the measurement (Not necessary in burst mode)
Voltage 500V 25.6 µs **Save** **Rx gain** 100× 3466 m/s **Start**	Save the result or: Adjust the gain settings. (See Chapter 3) or: Start a new measurement
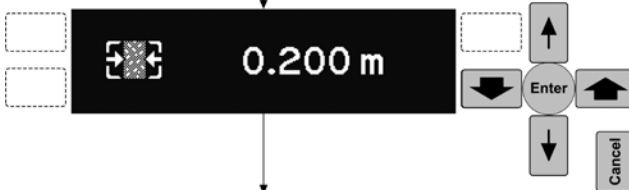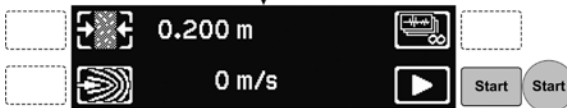
* Best results are obtained when the received signal level is around 75%. Use the automatic gain and voltage settings (See Chapter 3) for optimized performance.

5.4. Basic Measurement – Waveform Display

Select "Basic
Measurements"
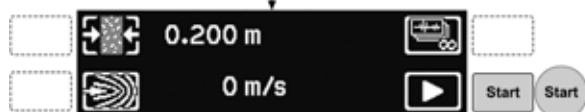
Start the measurement

Select "Waveform"
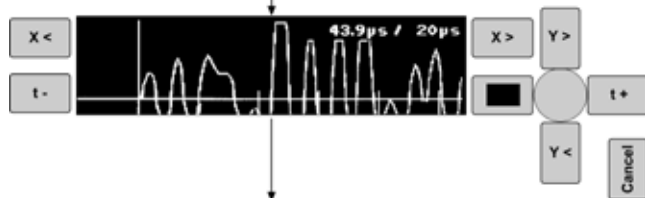
Adjust as required
(See below)

Cancel to return to
standard display

Waveform Controls

Y < >   Vertical zoom
X < >   Horizontal zoom
t - +   Manual trigger adjustment
▦   Stop/Start

Note 1: Rx gain may need reducing for vertical zoom to have a noticeable effect.
Note 2: Once adjusted, trigger point does not reset automatically unless a new measurement is started in the menu "Start the measurement"
Note 3: The waveform is not saved, only the transmission time.

5.5. Basic Measurement – Path Length

If the pulse velocity of the material under test is known, it is possible to measure the path length between the transducers. The procedure is exactly the same as for measuring pulse velocity except that in this case the known pulse velocity is entered.
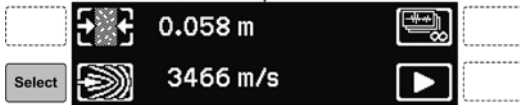
Select "proceq"	Select "Basic Measurements"
0.058 m / 3466 m/s	Select parameter setting "pulse velocity"
3610 m/s (Enter, Cancel, arrows)	Enter the pulse velocity
0.000 m / 3610 m/s (Start)	Start the measurement
25.6 µs / 0.075 m (Stop)	The display shows: - Transmission time - Measured path length - Received signal level Stop the measurement (Not necessary in burst mode)
Voltage 500V / Rx gain 100x / 25.6 µs / 0.075 m (Save, Start)	Save the result or: Adjust the gain settings. (See Chapter 3) or: Start a new measurement
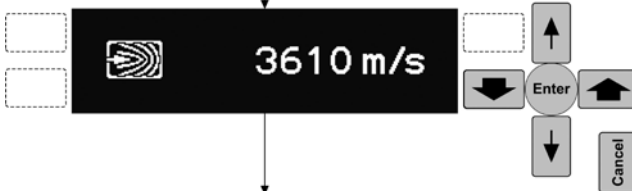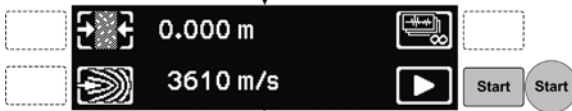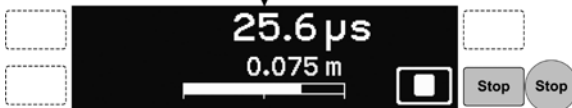
5.6. Basic Measurement – Compressive Strength (Pundit Lab⁺ only)

Prior to carrying out this measurement, a conversion curve must be created in PunditLink and uploaded to the instrument. Up to five curves may be stored on the instrument. Select the appropriate curve and set the desired compressive strength unit. (See chapter 3 "System Settings".) Carry out a pulse velocity measurement as described above (5.3).

While the measurement is being carried out, or when the measurement has completed, clicking on the up or down keys switches between pulse velocity and compressive strength indication.

SONREB Method

This method for measuring compressive strength combines the ultrasonic measurement with a rebound hammer measurement.

The format of the curve is: Compressive Strength $f_{ck} = aV^bS^c$

Where:
a, b and c are constants
V is the ultrasonic pulse velocity in m/s
S is the rebound value.

Many examples of SONREB curves can be found in the literature

In the settings menu (Chapter 3) the rebound value should be entered before carrying out the measurement. In this case the rebound value entered is saved along with the rest of the measurement data.
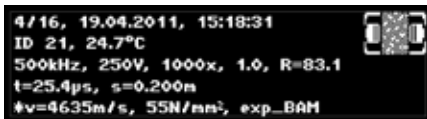
A rebound value of 83.1 has been entered here and saved with the measurement data.

 Note: The rebound value may be a Q-value (SilverSchmidt) or an R-value (Original Schmidt). This is for the user to define, but it is always displayed in the review list as "R for rebound value".

5.7. Compound Measurement – Surface Velocity

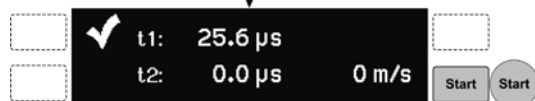Select "Compound Measurements"

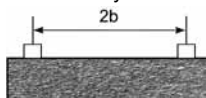Select "Surface Velocity"
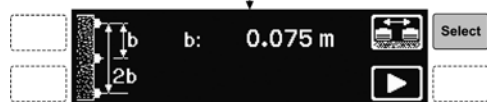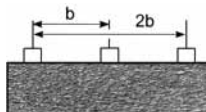
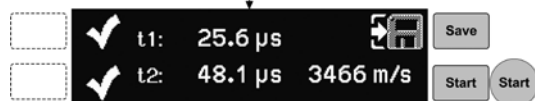Select parameter setting "b".
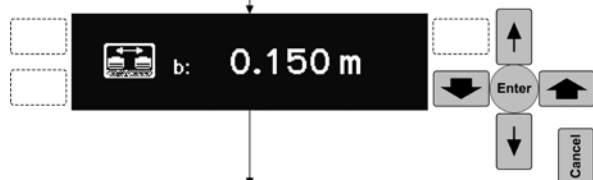
Measure and enter the distance "b"
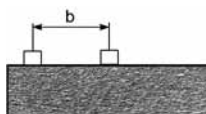
Transducers in first position – Start

"t1" is measured. Stable reading indicated by a tick

Receiver to 2nd position - Start

"t2" is measured. Stable reading is indicated by a tick and result screen is displayed.
The display shows:
- "t1"
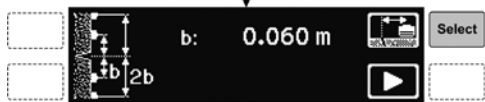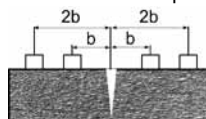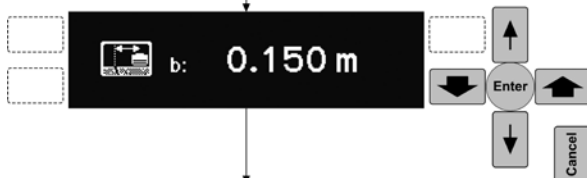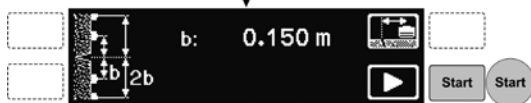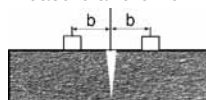- "t2"
- Surface velocity
Save the result or press start to repeat the measurement.

5.8. Compound Measurement – Perpendicular Crack Depth

Select "Compound Measurements"

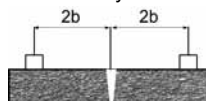Select "Crack Depth"

Select parameter setting "b".

Measure and enter the distance "b"

Transducers in first position – Start

"t1" is measured. Stable reading indicated by a tick

Transducers in 2nd position - Start

"t2" is measured. Stable reading is indicated by a tick and result screen is displayed.
The display shows:
- "t1"
- "t2"
- Crack Depth
Save the result or press start to repeat the measurement.

5.9. Minimum Dimensions

Minimum dimensions are recommended for accurate test results.

Minimum path length
100 mm for concrete with maximum aggregate size of 20 mm or less.
150 mm for concrete with maximum aggregate size between 20 mm and 40 mm.

Minimum lateral dimensions of the sample
This is dependent on the transmission wavelength and the pulse velocity. The minimum path length should be equal to or greater than the transmission wavelength, or a severe reduction in the pulse velocity may be detected. The following table taken from BS 1881: Part 203 shows the minimum recommended lateral dimensions for the test object.

Tx Frequency kHz	Pulse velocity 3500 m/s	Pulse velocity 4000 m/s	Pulse velocity 4500 m/s
	Minimum Lateral Dimensions of Test Object		
24	146 mm	167 mm	188 mm
54	65 mm	74 mm	83 mm
150	23 mm	27 mm	30 mm

5.10. Transducer Selection Guide

Generally, lower frequencies allow more depth of penetration. Higher frequencies allow better resolution in the measurements.

The inhomogeneities in concrete influence the propagation of an ultrasound pulse. This influence can be significantly reduced by choosing the frequency, f, such that the wave length, λ, is at least twice as large as the aggregate size. λ is given by:
$\lambda = c/f$,
where c is the pulse velocity (speed of sound) in concrete. The table below shows typical aggregate sizes and the corresponding maximum recommended frequency, respectively:

| c (m/s)	3500			4000			4500		
aggregate size (mm)	8	16	32	8	16	32	8	16	32
fmax (kHz)	219	109	55	250	125	63	281	141	70

5.11. 250 kHz Shear Wave Transducers

When measurements with the 250 kHz shear wave transducers are performed, it is crucial to use the special shear wave coupling paste, otherwise shear waves cannot be properly transmitted into the object under test. The shear wave coupling paste is a non-toxic, water soluble organic substance of very high viscosity.
Furthermore, we highly recommend using Pundit Link's waveform display in order to manually locate the onset of the shear wave echo. Since the latter is always preceded by a relatively weak longitudinal echo (see Figure below), the transit time determined by Pundit Lab, would correspond to the longitudinal instead of the shear wave.

Required steps before measurements can be performed

1. Put a small amount of shear wave coupling gel on the transducers.
2. Firmly press the transducers on either side of the 25 µs calibration rod (Part No 710 10 028). Make sure that the coupling gel is properly distributed and that no air is trapped between the transducer and the calibration rod.
3. Connect the transducers to Pundit Lab.
4. Select the 250 kHz transducer from the list of supported transducers (see Pundit Lab manual chapter 3 for more details).
5. Zero the instrument as described in the Pundit Lab manual chapter 2.1.
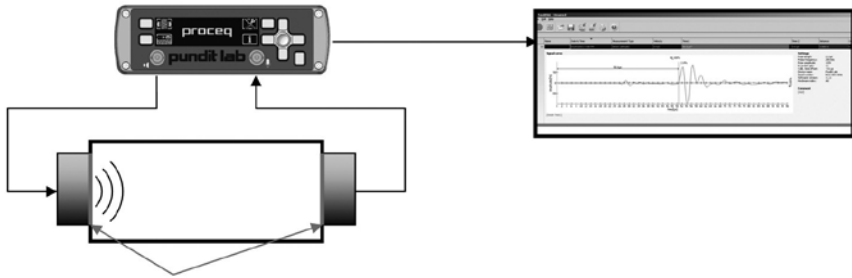
Performing measurements with the 250 kHz shear wave transducers.
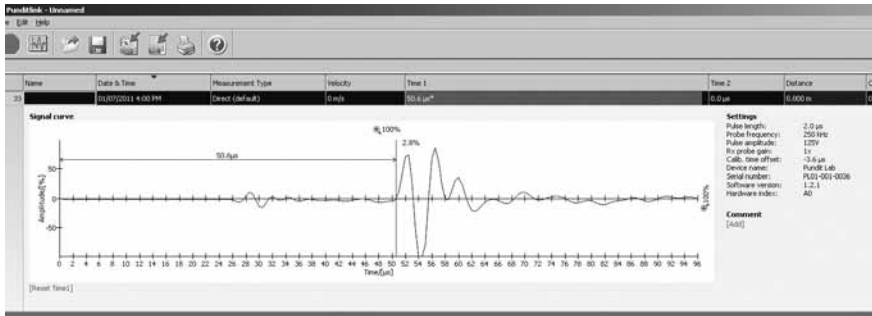
Typical echo signal obtained, with an experimental setup.

The first echo arrives at approximately 25.4 µs and corresponds to the weak longitudinal wave. After 50.6 µs the much stronger shear wave echo appears in the signal.

5.12. Transducer Holder Accessory

This accessory is particularly useful for compound measurements. (See chapter 5)

The individual transducer holders may be detached and used separately helping to reduce the physical strain when carrying out extensive measurements.

6. Technical Specifications

Transit time Measurement	
Range	0.1 – 9999 µs Auto ranging.
Resolution	0.1 µs
Display	79 x 21 mm passive matrix OLED
Transmitter	Optimized energizing pulse 125 V, 250 V, 350 V, 500 V, AUTO
Receiver	
Selectable gain steps Pundit Lab	1x, 10x, 100x, AUTO
Selectable gain steps Pundit Lab[+]	1x, 2x, 5x, 10x, 20x, 50x, 100x, 200x, 500x, 1000x, AUTO
Bandwidth	20 kHz – 500 kHz
Memory	Non volatile, > 500 measured values
Regional Settings	Metric and imperial units supported
Power Supply	
Battery	4 x AA batteries (> 20 hours continuous use)
Mains:	5v, <500mA via USB Charger
PC	5v, <500mA directly via USB cable
Mechanical	
Dimensions	172 x 55 x 220 mm
Weight	1.3 kg (incl. batteries)
Environmental conditions	
Operating temperature	-10° to 60°C (0° to 140°F)
Humidity	<95% RH, non condensing

7. Part Numbers and Accessories

7.1. Units

Part No.	Description
326 10 001	Pundit Lab consisting of: Display unit, 2 transducers (54kHz), 2 BNC cables 1.5 m, couplant, calibration rod, battery charger with USB-cable, 4x AA(LR6) batteries, data carrier with software, documentation and carrying case
326 20 001	Pundit Lab+ consisting of: Display unit, 2 transducers (54kHz), 2 BNC cables 1.5 m, couplant, calibration rod, battery charger with USB-cable, 4x AA(LR6) batteries, data carrier with software, documentation and carrying case

7.2. Transducers

325 40 026	Transducer 24 kHz (Two required for operation)
325 40 131	Transducer 54 kHz (Two required for operation)
325 40 141	Transducer 150 kHz (Two required for operation)
325 40 176	2 Exponential transducer 54 kHz, including calibration rod
325 40 177	Transducer 250 kHz (Two required for operation)
325 40 175	Transducer 500 kHz (Two required for operation)
325 40 049	2 Shear wave transducers 250 kHz, including couplant

7.3. Parts and Accessories

326 80 211	Pundit lab carrying bag
325 40 059	Amplifier for long cables (>10m) and exponential transducer (not required for Pundit Lab+)
325 40 021	Cable with BNC-plug, L=1.5m (5ft)
711 10 005	Cable with BNC-plug, L=3.0m (10ft)
325 40 022	Cable with BNC-plug, L=10m (33ft)
325 40 024	Cable with BNC-plug, L=30m (100ft)
710 10 031	Ultrasonic couplant, 250 mL bottle
325 40 048	Shear wave couplant
710 10 028	Calibration rod 25 µs for Pundit
710 10 029	Calibration rod 100 µs for Pundit
351 90 018	USB cable 1.8m
341 80 112	USB charger, global
326 01 033	Demo Block Pundit Lab
325 40 150	Transducer Holder complete

8. Maintenance and Support

Error Screen

If this screen appears during measurements,
it indicates that no stable signal has been received.

If this occurs :
Do the measurement in continuous mode.
Change voltage pulse or gain.
Use the waveform display to determine optimal voltage and gain settings.

1.0	Signal too weak
2.0	Invalid measurement (The condition t1 >t2/2 during crack-measurement is not fulfilled)
11.0	Memory full
37.0	Pundit Lab+ only. Invalid system time (Back-up battery for the real time clock is probably empty)

Support Concept

Proceq is committed to providing a complete support service for this instrument by means of our global service and support facilities. It is recommended that the user register the product on www.proceq.com to obtain the latest on available updates and other valuable information.

Standard Warranty and Extended Warranty

The standard warranty covers the electronic portion of the instrument for 24 months and the mechanical portion of the instrument for 6 months.
An extended warranty for one, two or three years for the electronic portion of the instrument may be purchased up to 90 days of date of purchase.

9. Pundit Link

9.1. Starting Pundit Link

Locate the file "Punditlink Setup.exe" on your computer or on the CD and click on it. Follow the instructions you see on the screen.
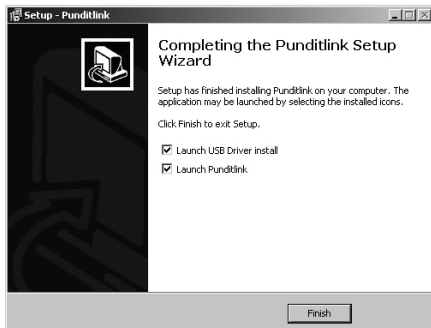
Make sure that the "Launch USB Driver install" tick is selected.

The USB driver installs a virtual com port which is needed to communicate with the Pundit.

Double click on the Pundit Link Icon on your desktop or start the Pundit Link via the start menu.
The Pundit link starts with a blank list.
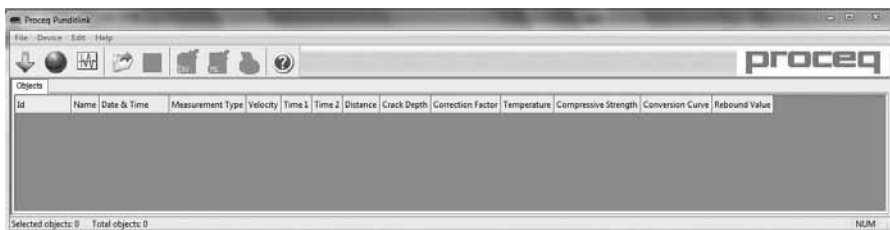
Application settings

The menu item "File – Application settings" allows the user to select the language and the date and time format to be used.

Connecting to a Pundit
Connect the Pundit to a USB port, then select one of the following options:

To download all data from the Pundit.

To begin the "Live view" mode for remote controlled measurements and waveform analysis.

In both cases the following window will be displayed:

Leave the settings as default or if you know the COM port you can enter it manually.

Click on "Next >"

When a Pundit has been found its details will be displayed on screen. Click on the "Finish" button to establish the connection.

9.2. Viewing the Data

The data stored on your Pundit will be displayed on the screen:

- An "Id" number identifies the measurement object.
- The "Name" column allows the user to assign a name for the measurement object.
- The "Date and time". For Pundit Lab this is the time when the data is downloaded on to the PC, or in "Live view" mode, the date and time when the measurement was made. For Pundit Lab+ it is the date and time when the measurement was made.
- The "Measurement type" indicates either "direct" or one of the compound measurement types.
- The "Velocity" column displays the measured pulse velocity or the setting for path length measurements.
- "Time 1" and "Time 2" displays the measured transmission time or times for compound measurements.
- The "Distance" column shows the measured distance or the setting for pulse velocity measurements.
- The "Crack Depth" shows the measured crack depth.
- The "Correction Factor" shows the setting of the correction factor.
- For Pundit Lab+ only: The "Compressive Strength" shows the calculated value based on the chosen "Conversion Curve".
- For Pundit Lab+ only: The "Rebound Value" is the value entered (SONREB method only)

Click on the double arrow icon in the "Id" column to see more details:

Note: Click on "Add" to attach a comment to the object.

9.3. Adjusting the Settings

Each of the settings that were used in the Pundit at the time of the measurement series can be adjusted subsequently in Pundit Link. For compressive strength measurements made with Pundit Lab+ the conversion curve and rebound value can be adjusted subsequently. This can be done either by right clicking directly on the item in the appropriate column, or by clicking on the blue setting item in the detailed view of a measurement object. In each case a drop down selection box will appear with the choice of setting.

Adjusting the date and time

Right click in the "Date & Time" column.

The time will be adjusted for the selected series only.

Please note, the Pundit Lab does not have an internal clock, so the date and time displayed for downloaded data, is the time at which it was downloaded.

In "Data Logging" mode it is the date and time at which the measurement was made.

9.4. Exporting Data

Pundit Link allows you to export selected objects or the entire project for use in third party programs. Click on the measurement object you wish to export. It will be highlighted as shown.

Click on the "Export as CSV file(s)" icon. The data for this measurement object is exported as a Microsoft Office Excel comma separated file or files. The export options may be chosen in the following window:
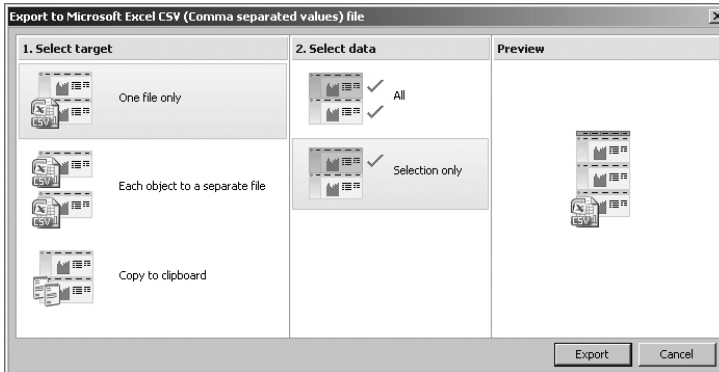
Click on the "Export as graphic" icon to open the following window which allows the various export options to be chosen.

In both cases, the preview window shows the effects of the current output selection.
Finish by clicking on export to select the file location, name the file and in the case of a graphical output to set the output graphic format: .png, .bmp or .jpg

9.5. Deleting and restoring Data

The menu item "Edit – Delete" allows you to delete one or more selected series from the down-loaded data.

	Note: This does not delete data from the Pundit, only data in the current project.

The menu item "Edit – Select all", allows the user to select all series in the project for deletion, exporting etc.

Restoring original downloaded data

Select the menu item "File – Restore all original data" to restore the data to the original format as it was downloaded. This is a useful feature if you have been manipulating the data, but wish to go back to the raw data once again. A warning will be given to say that the original data is about to be restored. Confirm to restore.

	Note: Any names or comments that have been added to series will be lost.

Deleting data stored on the Pundit

Select the menu item "Device – Delete all measurements object on Pundit" to delete all data stored on the Pundit. A warning will be given to say that all of the data is about to be deleted. Confirm to delete.

	Note: This will delete every measurement series. It is not possible to delete individual series.

9.6. Further Functions

The following menu items are available via the icons at the top of the screen:

"PQUpgrade" icon - Allows you to upgrade your firmware via the internet or from local files.

"Open project" icon – Allows you to open a previously saved .pql project.

"Save project" icon – Allows you to save the current project.
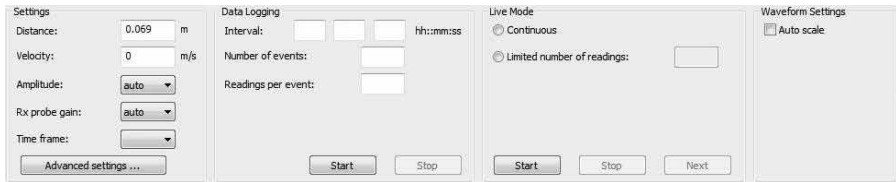
"Print" icon – Allows you to print out the project. You may select in the printer dialog, if you want to print out all of the data or selected readings only.

9.7. Live View

Pundit Lab allows you to remotely control the Pundit Lab and to view the waveform directly on the PC screen.

Click on the "Live view" icon. If you are not already connected to the Pundit, the connection sequence will be initiated. (See 9.1). The "Live view" window will be displayed.

All transmission parameters may be controlled here. Click on the "Advanced settings …" button to adjust the following parameters:

Please note that the pulse width is by default set to an optimum value for the transducer frequency selected.

Time frame
Can be set between 0.1ms and a maximum of 10ms. (please note, 10 ms corresponds to a measurement of approximately 40m through concrete. Typical measurements will be less than 0.5ms. This setting sets the time scale for the waveform display as can be seen below.

e.g. Recording time set to 0.2 ms
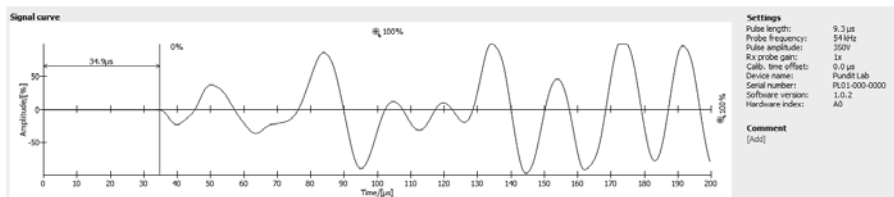
e.g. Recording time set to 0.5 ms
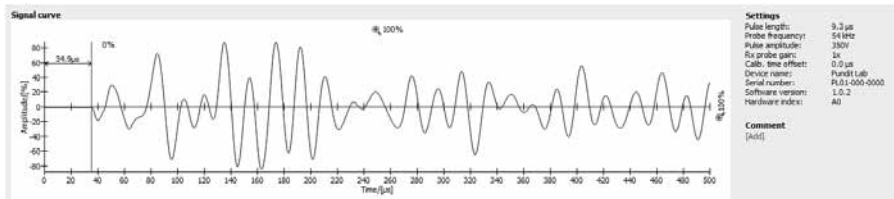
e.g. Recording time set to 5ms
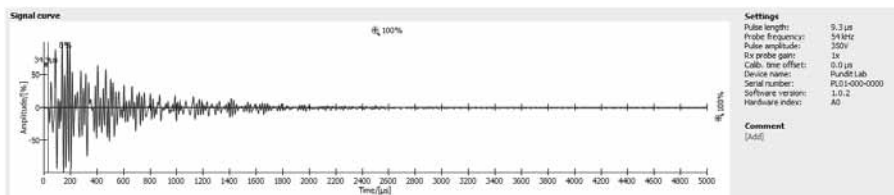
Setting the trigger point manually

Pundit Link gives the user the option to set the trigger point manually. See the example below.

Trigger point capture automatically.
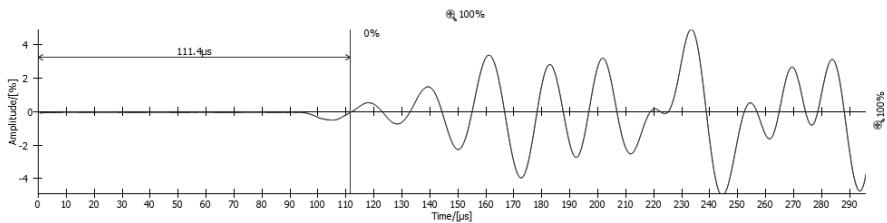
Zoom in by clicking on the time and amplitude scale zoom buttons for fine adjustment.
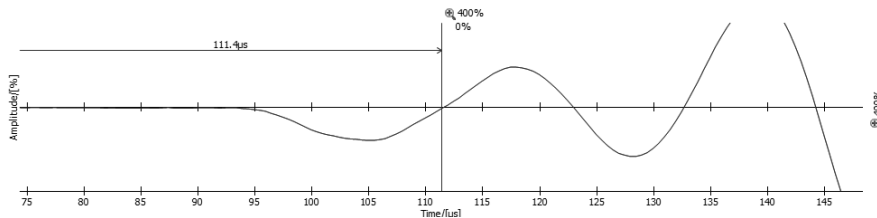
Click and drag the blue line to adjust the trigger point manually.
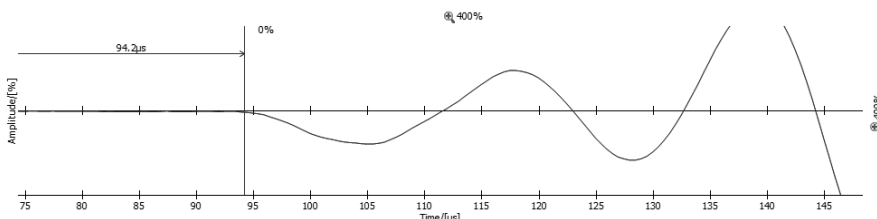
| i | **Note:** In this example the signal amplitude is very low. Use higher output voltage settings and gain settings for better results. |

Data Logging

The Data Logging mode allows the user to program a test sequence.
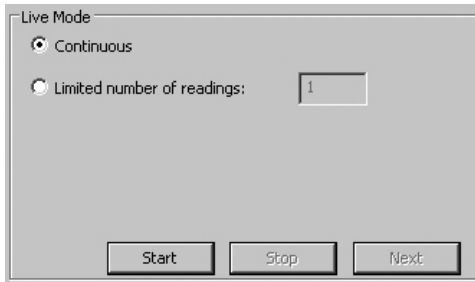
Interval – between measurements.

Number of events – until the test is completed.

Readings per event – how many measurements are made in each interval.

Live mode

The live mode allows the user to test with or without recording the data.
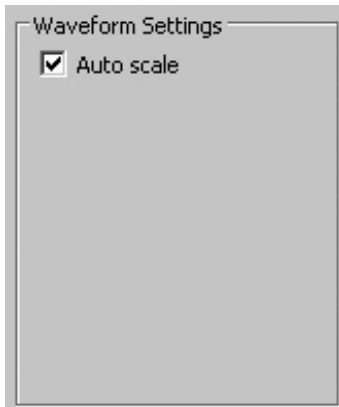
In continuous mode, the Pundit Lab begins measuring as soon as "Start" is pressed and continues until "Stop" is pressed.

If a limited number of readings only is required, this may also be set.

Pressing "Next" logs the data and allows a new measurement to begin.

Waveform settings

Clicking "Auto Scale" adjusts the zoom parameters of the waveform display to an optimum setting.

9.8. Conversion Curves

Pundit Lab+ allows compressive strength estimates to be made using pulse velocity measurements or a combination of pulse velocity and rebound hammer measurements.
To do this it is necessary to create a conversion curve and upload this onto the instrument.

Conversion curves are very much specific to the concrete under test and there are many examples in the literature.

Pundit Lab+ allows either polynomial curves or exponential curves to be programmed and in the case of a combined ultrasonic/rebound value measurement a curve based on the SONREB (SONic REBound) method may be entered.

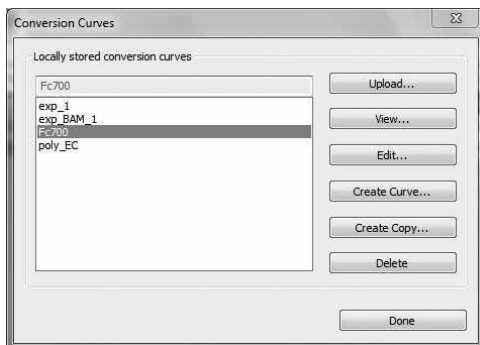Select the menu item "Conversion Curves"
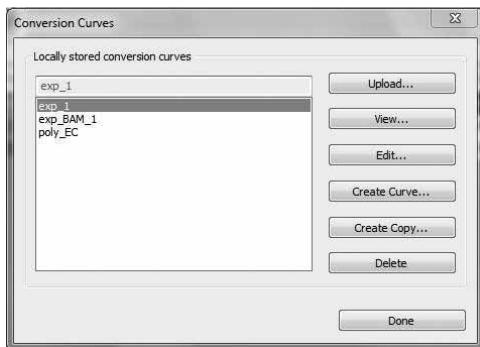
Here you can view existing curves stored on your computer, copy an existing curve for modification or:

Create new curve.
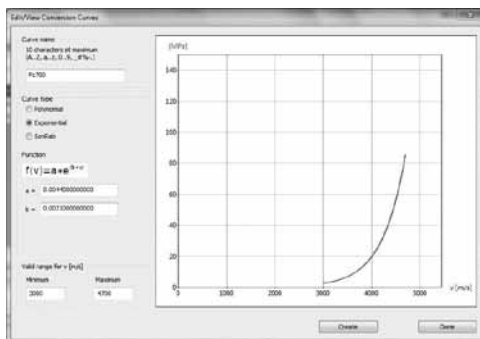
Enter the curve parameters and click on "Create".

The new curve will now appear in the drop down list and may be loaded onto the Pundit Lab⁺.

10. Pundit Lab Remote Control Interface

The Pundit Lab interface is completely open for those users who do not wish to use the PunditLink software but instead wish to integrate Pundit Lab into the software they use in the laboratory such as LabVIEW.

The remote control interface document providing complete instructions is available in the downloads section on the Proceq website www.proceq.com.

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