# PUNDIT Lab

**Purpose**

The **PUNDIT** (**P**ortable **U**ltrasonic **N**ondestructive **D**igital **I**ndicating **T**ester) **Lab** is used to measure the propagation speed of a pulse of ultrasonic longitudinal stress waves. The ultrasonic pulse velocity (UPV) that is determined can be used for the following applications:

- Evaluating the uniformity of concrete within a structural member
- Locating internal voids and cracks
- Estimating the depth of surface-opening cracks
- Estimating severity of deterioration
- Estimating depth of fire damaged concrete
- Evaluating effectiveness of crack repairs
- Identifying anomalous regions for invasive sampling with drilled cores
- Estimating early-age strength (with project specific correlation)

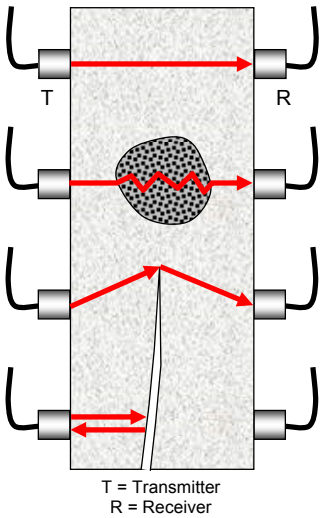
**Principle**

A pulse of ultrasonic (> 20 kHz) longitudinal stress waves is introduced into one surface of a concrete member by a transducer coupled to the surface with a coupling gel or grease. The pulse travels through the concrete and is received by a similar transducer coupled on the opposite surface. The transit time of the pulse is determined by the instrument. The distance between the transducers is divided by the transit time to obtain the pulse velocity. The longitudinal pulse velocity, $C_p$, of an elastic solid is a function of the elastic constants (modulus of elasticity, $E$, and Poisson's ratio, ν) and the density, ρ.

$$C_p = \sqrt{\frac{E(1-\nu)}{\rho(1+\nu)(1-2\nu)}}$$

The UPV test method is governed by various standards including ASTM C597, BS 1881:203, and EN 12504-4. The test method is totally nondestructive and it is possible to repeat the test at the same point at different times to monitor change of UPV with time.

The figure to the right illustrates different conditions that may be encountered when testing an element using the UPV method. At the top, the path between the transducers is through solid concrete, and the travel time would be the shortest. Below that is the case where there is an internal pocket of porous concrete, such as honeycombed concrete. The pulse is scattered as it travels though the contiguous portions of the honeycombed concrete. As a result, the actual travel path is longer than the distance between the transducers and the pulse travel time is longer. This results in a reduced pulse velocity. In the next case, the transducers are located so that the direct travel path is near the edge of a crack. The pulse cannot travel across a concrete-air interface (see pg. 52), but it is able to travel from the transmitter to the receiver by diffraction at the crack edge. Because the travel path is longer than the distance between the transducers, the apparent pulse velocity is lower than through sound



concrete. In the lowermost case, the pulse is reflected completely by the crack, and travel time is not measurable.

**Precision and Accuracy**

The UPV test is highly repeatable. For tests of sound concrete, the coefficient of variation for repeated measurements at the same location is 2 %. The accuracy of the pulse velocity depends, in part, on the accuracy of the measured distance between the transducer faces.

**Models**

Two models are available: The **PUNDIT Lab** and the **PUNDIT Lab+**. Both instruments are capable of investigating the structural integrity of concrete, ceramics and refractory, timber, and other materials. The instruments include the following features:

- Light, portable, rugged, simple to operate
- USB rechargeable battery and 110/240 VAC 50/60 Hz power supply
- Large, highly visible LCD display
- USB and oscilloscope outputs
- Large range of transducer options (24 kHz to 500 kHz)
- Auto ranging transit time display; up to 9999 µs
- Transit time resolution of 0.1 µs
- Integrated received waveform display on instrument
- Integrated gain stage
- Measure transit time, pulse velocity, and elastic modulus (with shear wave transducer)
- Five transmitter voltage options; 125V, 250 V, 350 V, 500 V, or AUTO
- Operating temperature range for transducers is -10 to 60 ºC.
- Pundit Link software for data transfer to computer, remote control of instrument settings, and exporting data

In addition to these features, the **PUNDIT Lab+** has the capability to accept pre-established strength relationships for estimating in-place strength. This includes the ability to use the SONREB method in which rebound number and UPV are used in combination to estimate compressive strength. In addition, a time stamp is provide for all measurements and all stored measurements can be reviewed on the instrument.

**PUNDIT Lab Ordering Numbers**

| Item | Order # |
|---|---|
| **PUNDIT Lab** consisting of: Display unit, 2 transducers (54kHz), 2 BNC cables 1.5 m, couplant, verification rod, battery charger with USB-cable, 4x AA(LR6) batteries, Pundit Link software, documentation and carrying case | PL-1010 |
| **PUNDIT Lab+** consisting of: Display unit, 2 transducers (54kHz), 2 BNC cables 1.5 m, couplant, verification rod, battery charger with USB-cable, 4x AA(LR6) batteries, Pundit Link software, documentation and carrying case | PL -1020 |

**Transducers**

| Order # | Frequency* |
|---|---|
| UTR24K | 24 kHz |
| UTR54K | 54 kHz |
| UTR54K-E exponential | 54 kHz |
| UTR150K | 150 kHz |
| UTR250K | 200 kHz |
| UTR250K-S shear wave w/couplant | 250 kHz |
| UTR500K | 500 kHz |

*Maximum frequency should not exceed the UPV divided by two times the maximum aggregate size.