User's Guide

FAKOPP
ULTRASONIC TIMER

(ES) Equipements Scientifiques SA - Département Bio-Tests & Industries - 127 rue de Buzenval BP 26 - 92380 Garches
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Introduction

Ultrasonic velocity is a basic parameter for nondestructive evaluation of tree, seedling, wood, veneer, wood panel products and concrete. Defect localization and material property determination is possible by measuring ultrasonic velocity. This equipment designed for veneer and seedling tests.

Operation principle

Two identical piezo-electric transducer is connected to the material. A short ultrasonic impulse is generated by electronic excitation of the transducer and at the same time, timer starts running. The sound propagates in the material and after a while reach the second transducer. The signal of the second (receiver) transducer stop the timer, when the signal reaches the threshold level (0.12 V), see figure 1. The transit time appears on the screen of the equipment in microseconds.

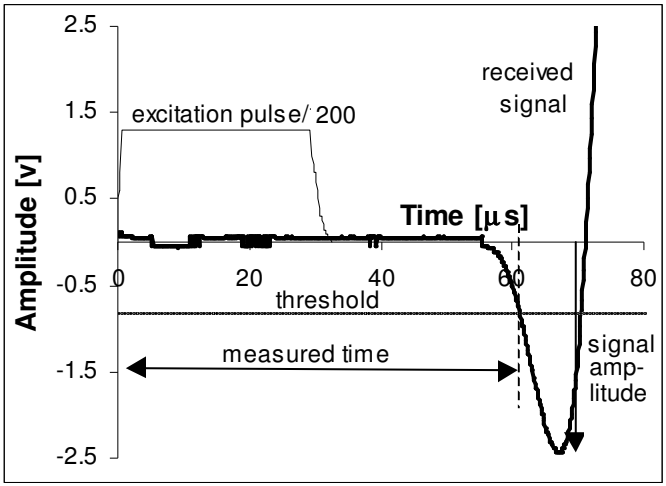

Figure 1. Timer starts, when excitation pulse rise and stops when received signal reaches the threshold level. (The received signal polarity is opposite in this unit!)

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Time correction:

The transit time appears on the screen, includes the transit time inside the transducer. The wave guide (triangle or spike) is part of the transducer. If we measure the distance between the screw locations (center of triangle wave guide) we have to subtract 6.1µs from the readout, to get the correct transit time in the sample. Using this corrected time and distance data, correct ultrasonic velocity determination is possible. Distance defined as the distance between the transducer center, see figure 2.

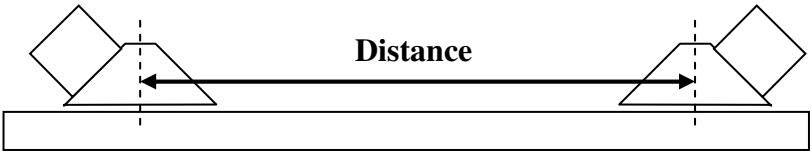

Figure 2. Distance determination.

Determination of the time correction is done by the following technique. The read out time is recorded while distance between transducers vary between 9 and 47 cm. The material used for the test was sound spruce lumber. The intercept of distance - read out line determines the time correction. See figure 3. The intercept and the time correction is 6.1.

A theoretical determination of time correction is based on the stress wave velocity in aluminum and the total length of the sound path in aluminum. Velocity is 5100 m/s at room temperature and the distance is 0.03 m. The calculated time: t=0.03/510 s e.g. 5.9 µs. This value is in a good coincidence with the measured data: 6.1 µs.

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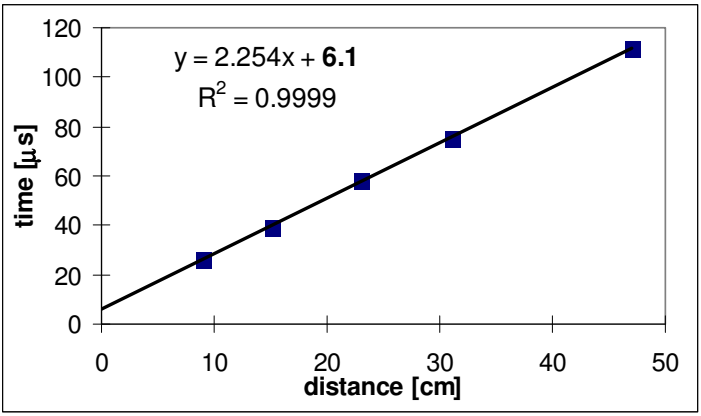

Figure 3: Measured time as a function of distance.

Velocity determination:

V[m/s]=1000*distance[mm] **/** (read out[µs]-**time correction**)

Time correction for transducers equipped with spike

Distance between transducers is measured between the points, where the transducers are inserted into the seedling. The penetration depth of the spike, effect the time correction. We applied 10 mm penetration depth, measured in spike direction.

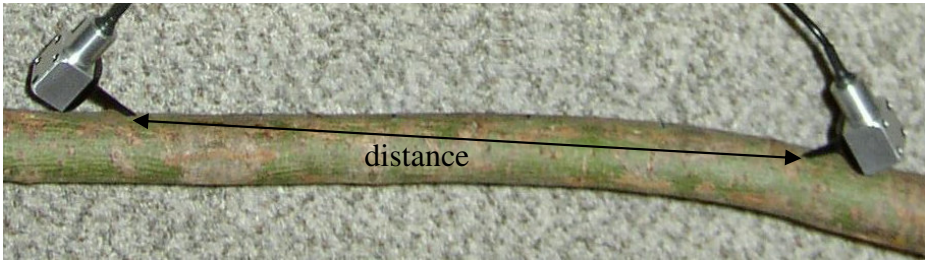

Figure 4: The applied setup for seedling test.

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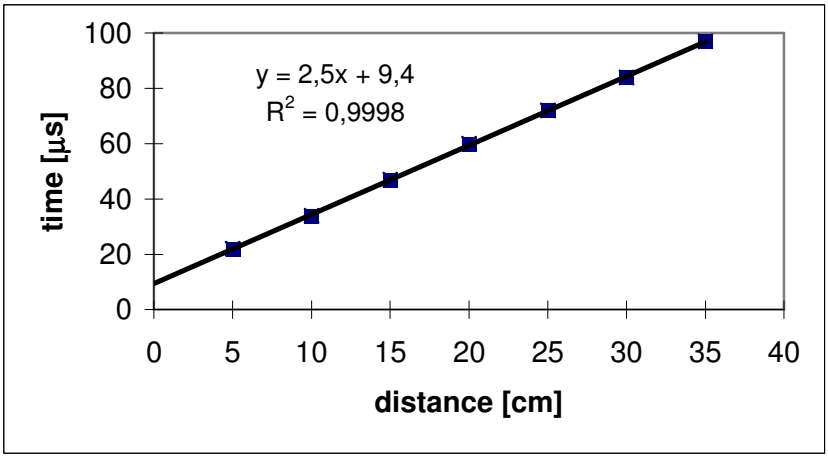


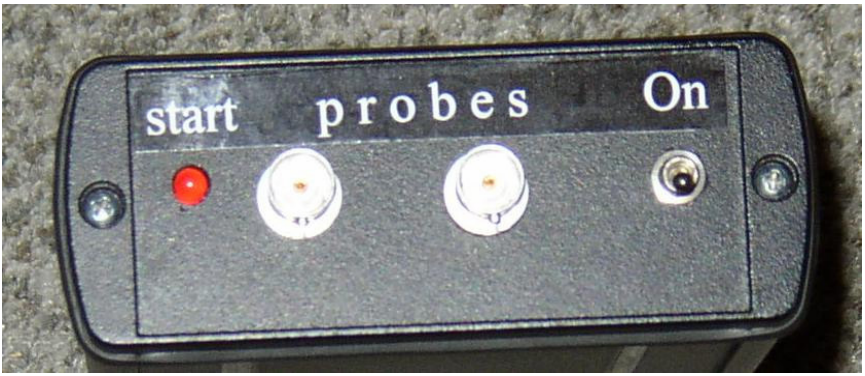
Figure 5: The time correction determination. Conditions: material green willow branch, spike penetration was 10 mm.

The measured time correction according to figure 5 is 9.4 µs.

Installation

This section describes the installation step by step.

1.) Connect two pieso-electric transducer's cables to "probes" connector of the timer.



The transducers are identical, so if you change the two transducer cable you will measure the same transit time. Technically the

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function of the two "Probes" connector is different. The connector close to the switch sends a pulse (200 V unipolar square pulse, duration 60µs) once per 2 seconds, repetition rate is 0,5 Hz. The connector close to the led receives the signal.

3.) Couple the transducer to the sample. Poor coupling results poor or wrong result.

4.) Switch on the timer.

5.) Transit time including the time correction in µs appears on the screen. The first readout after switch on is "0000". This is normal.

6.). Please check 2-3 readouts. If the deviation between the readouts is 0 or 1 µs, accept the data. Record the readout and change sample.

A vibration free environment is necessary during the test, because the outside signal may interfere with the ultrasonic signal. The equipment sensitivity for low frequency vibration is low.

Sensitivity considerations

The transducer (with 25 mm long spike) frequency is 90 kHz. The attenuation of the signal in seedling is high, comparing to dry wood.

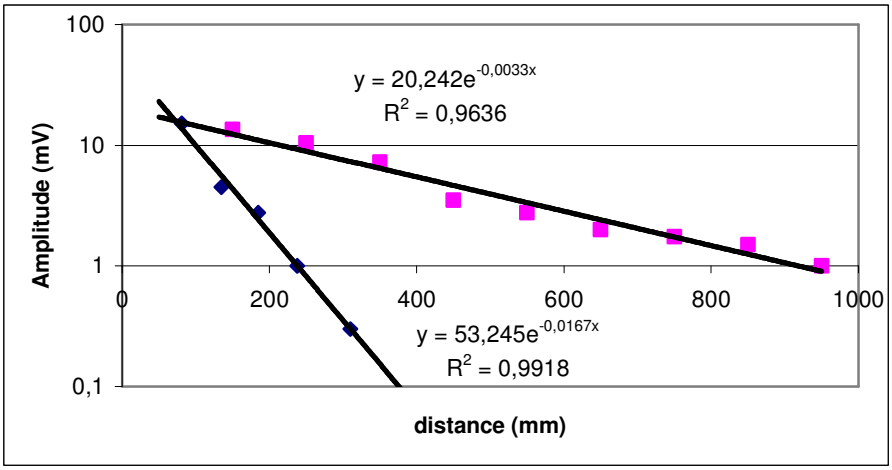

Figure 6: Attenuation of the 90 kHz ultrasonic pulse. Upper line from dry larch, lower and aslope line is from wet willow branch. Amplitude of the first peak measured at the receiver sensor, without amplification.

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By increasing the distance between the probes, the received signal is decreasing. Figure 7 shows the received signal.

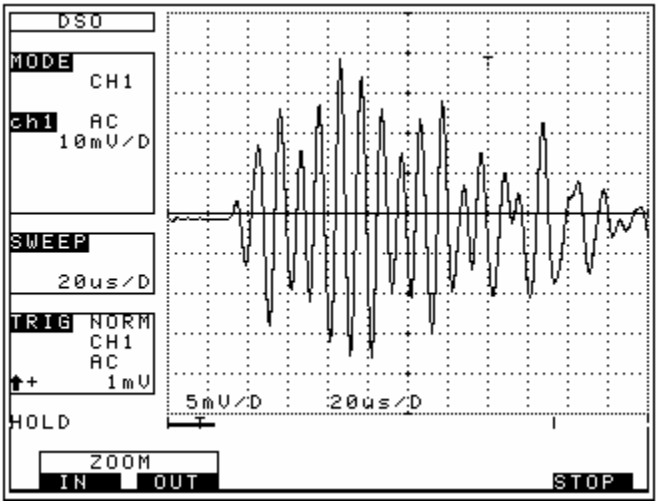

Figure 7: The received signal.

After a point the amplitude of the first peak becomes lower than the threshold level and the read out becomes 11 µs higher because the low signal.

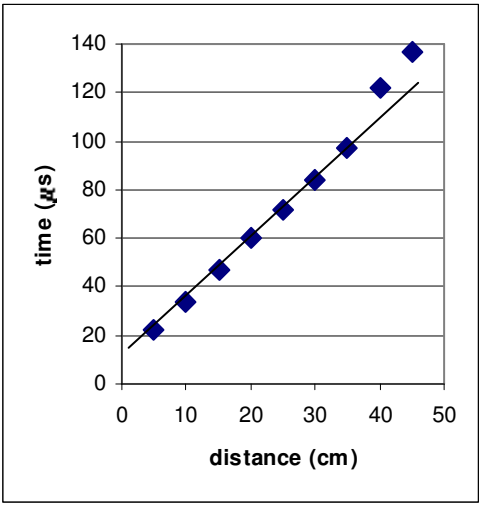

Figure 8: The measured time over 35 cm becomes higher by 11.

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To avoid the situation in figure 8, we recommend to use short transducer distance. **The recommended transducer distance is 25-30 cm only.**

Transducers

for veneer

The 45 kHz piezo electric transducers are designed specially for wood and veneer evaluation. A special triangle shape wave guide makes the transducer suitable for longitudinal test when the side (no end surface) of the sample is accessible. The required force for proper coupling is 100-200N.

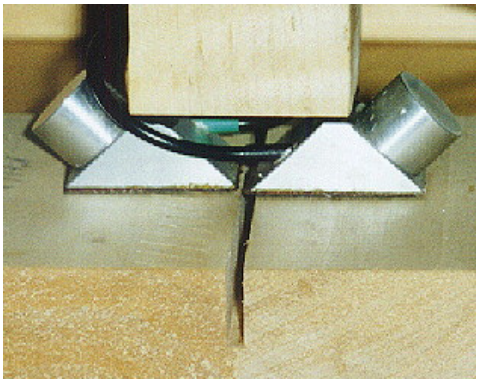

Figure 9. The triangle shape transducer pair.

Transducer for seedling

The transducer for seedling test is equipped wit an integrated 25mm long spike. The ultrasonic frequency is 90 kHz. The material of the transducer end is aluminum, so please **do not hit the transducer**. Press it into the seedling by finger. Take care of your finger, because the transducer tip is sharp. The required depth of the spike penetration is depends on the bark thickness. Spike need to penetrate the bark, other hand need to fix the probe in the wood material. “Normal” value is 6-10 mm. The correct spike orientation to the grain is 45 +/- 15 degree.

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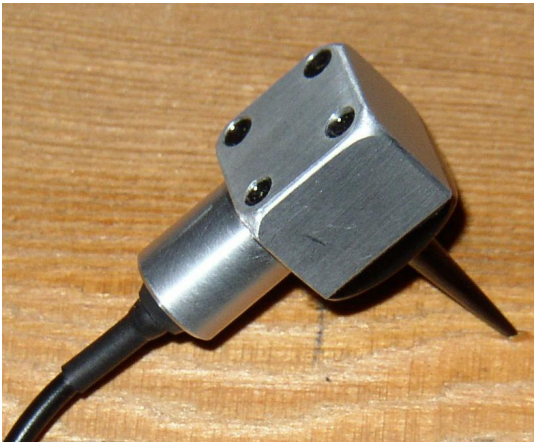

Figure 10: The transducer for seedling test

Maintenance

No special maintenance is required. Keep clean the unit, especially the connectors. The only one regular maintenance is the battery change.
Two 250mA capacity rechargeable batteries is enclosed, provides almost 20 hours operation.

Battery change

The ultrasonic timer has two independent circuits, the use of two batteries is a mist. The timer unit has “LOW BAT” indicator. When voltage goes below 8,5 V the “LOW BAT” sign appears at the top right corner of the display. This case please change battery.
When the excitation circuit battery is low, no signal is generates and the start led stops flashing. This case please change battery.
IMPORTANT: Always switch of unit before battery change!!!
Open battery compartment (figure 11.) and change the battery.
You can recharge the battery. Unfortunately we are not able to provide battery charger for 110V.

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Figure 9: The open battery compartment.

Guarantee:

For the Ultrasonic Timer device the guarantee is one year. The guarantee starts at the date displayed on the bill and valid for the following one year. The repair can be asked from the manufacturer, fax: +36 99 33 00 99. The guarantee does not concern to the break or deliberate damage of the machine.

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Technical data

Weight incl. batteries:	910 g
Dimensions:	297 x 106x 45 mm
Material of the house:	Al
Timer frequency range:	15-300 kHz
Time resolution:	+/- 1 µs
Signal amplification:	1000x
Threshold level:	120 mV
Excitation pulse:	one in 2sec
Excitation pulse voltage:	200 V
duration :	60 µs
shape:	uni-polar, square
Powered by	two 9 V block
Power consumption, timer:	70 mW
excitation unit:	120 mW
Ultrasonic transducer frequency	
with spike wave guide:	90 kHz
with triangle wave guide:	45 kHz
Operation and storage temperature:	0 - 35 C^{o}

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