

Proceq SA
Ringstrasse 2, Postfach 336
CH-8603 Schwerzenbach
Switzerland

Tel. +41 (0)43 355 38 00
Fax +41 (0)43 355 38 12
www.proceq.com
info@proceq.com

Bedienungsanleitung
Operating Instructions
Mode d'emploi

TICO

Ultraschallgerät
Ultrasonic Instrument
Appareil à ultrasons



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Operating Instructions

The ultrasonic instrument is used for the non-destructive testing of concrete. In particular, the following properties can be determined:

- Uniformity of the concrete
- Cavities, cracks, defects due to fire and frost
- Elasticity module (indirectly via BS 1881, part 203)
- Concrete strength



Subject to change

Form supplied

Display unit

with nonvolatile memory for up to 250 measured values, 128 x 128 graphic LCD.

RS 232 C interface.

Integrated software for transmission of the measured values to PC.

Measuring range: approx. 15 to 6550 μ s

Resolution: 0.1 μ s

Voltage pulse: 1 kV

Pulse rate: 3/s

Impedance at input: 1 M Ω

Temperature range: -10° to +60° C.

Battery operation with six LR 6 batteries, 1.5 V for 30 hours.

2 Transducers 54 kHz

2 Cables BNC, L=1.5 m

Calibration rod

Coupling paste can with 150 ml

Carrying strap, operating instructions and

carrying case 325 x 295 x 105 mm, total weight 3.4 kg.

Accessories

Transducers with other frequencies, BNC cable length 10 m, transfer cable.

A. Putting into operation

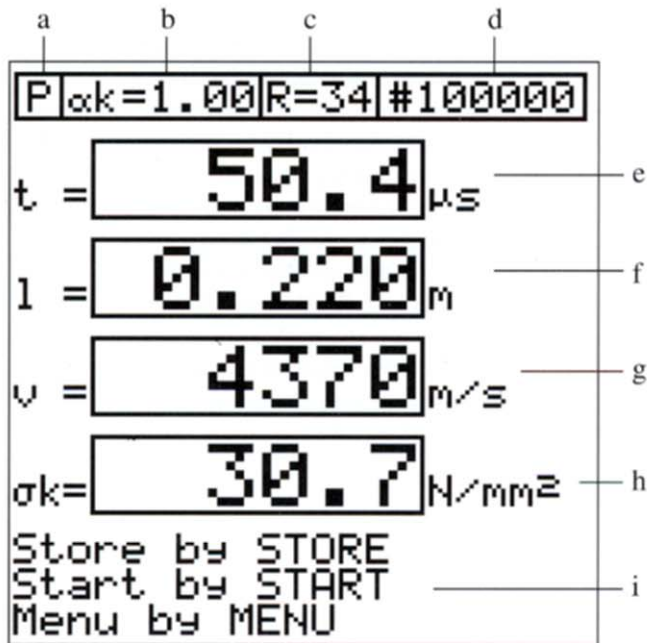
- Connect BNC cable to transducers and display unit. If cables of different lengths are used, the longer cable should be connected to the transmitter socket (transmit).

Important: The transducers must be connected before the unit is switched on and must be disconnected only after switching off. Electrical shock may occur if interior of BNC plug of the transmitter cable (transmit) is touched.

- Press the «ON» key. The following is displayed briefly:
 - the number of the display unit
 - the installed software version
 - the remaining life of the batteries

If no display appears, the batteries should be replaced.

The following measurement image then appears:



- a Cement type: P for Portland cement
B for blast furnace cement
- b Correction factor for moisture or other influences
- c Rebound value is input on the keyboard
- d Measurement number
- e Transmission time of the sound waves between the transducers
- f Distance between the transducers
unit preselectable: m, ft
- g Pulse velocity $v = l/t$
- h Concrete strength TICO-SCHMIDT
unit preselectable: N/mm^2 , MPa, kg/cm^2 , psi
- i Instructions for operation

B. Settings in the MENU

The indicator unit has a menu system with user guidance. Please follow the instructions in the respective display field.

The «MENU» key displays the following:

■ Distance	
□ Reboundvalue R	
□ Correction factor	
□ Test No.	
□ Basic Setups	
□ Language	
□ Crack depth	
□ Surface Velocity	
□ Automatic Storing	
□ Data Output	
Select by ↑↓	_____ a
Start by START	_____ b
End by END	_____ c

- a choose menu line
- b call up chosen line
- c call up measurement image

Notice to chapter B2.

The strengths determined with diagram A or B respectively displayed by the TICO correspond to the strengths of sample cubes of 200 mm side lengths.

If different sample forms are used, the strengths must be converted with the corresponding form factor (refer to the special INFO-sheet).

1. Distance

For automatic display of the pulse velocity in the measurement screen, the distance between the transducers must be input with an accuracy of 1% using the $\uparrow \downarrow \leftarrow \rightarrow$ keys. Input in m or ft (see under 5.1).

2. Rebound value R (concrete strength)

Test report CUR 69 of the TNO (The Netherlands) describes the method with which the concrete strength can be calculated using a combination of the rebound value of a SCHMIDT hammer type N and the pulse velocity. This mathematical relationship was derived from the test results of more than 700 test samples. After the mean rebound value R has been input at the appropriate test point, the cement type Portland or blast furnace must be chosen. Applicability: A calculation of the concrete strength is displayed in the measurement image under $\sigma_k =$ only when the measured pulse velocity is in the range of the curve shown (e.g. in Diagram A, v must be between 3'900 m/s and 4'450 m/s at R 30).

If this is not the case, no strength is displayed.

In this case, the minimum strength can be determined with the measured speed of the sound waves and diagram A, respectively diagram B (e.g. in Diagram A for R = 30 and $v = 3'800$ m/s, $f_{ck} = 12$ N/mm²).

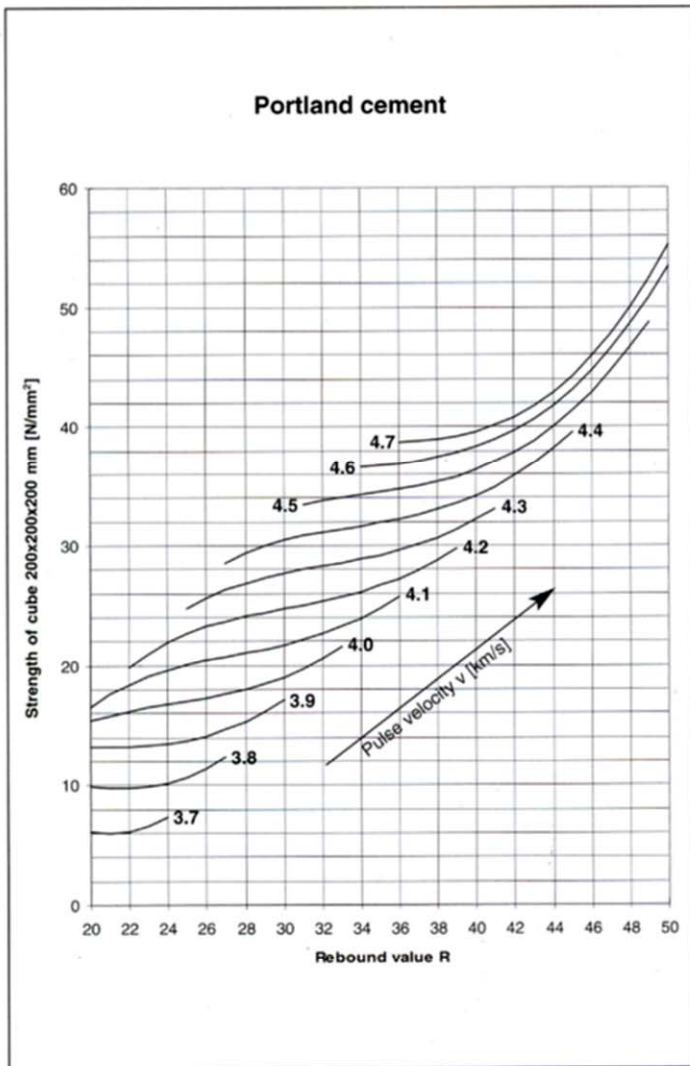


Diagram A Concrete strengths f_{ck}

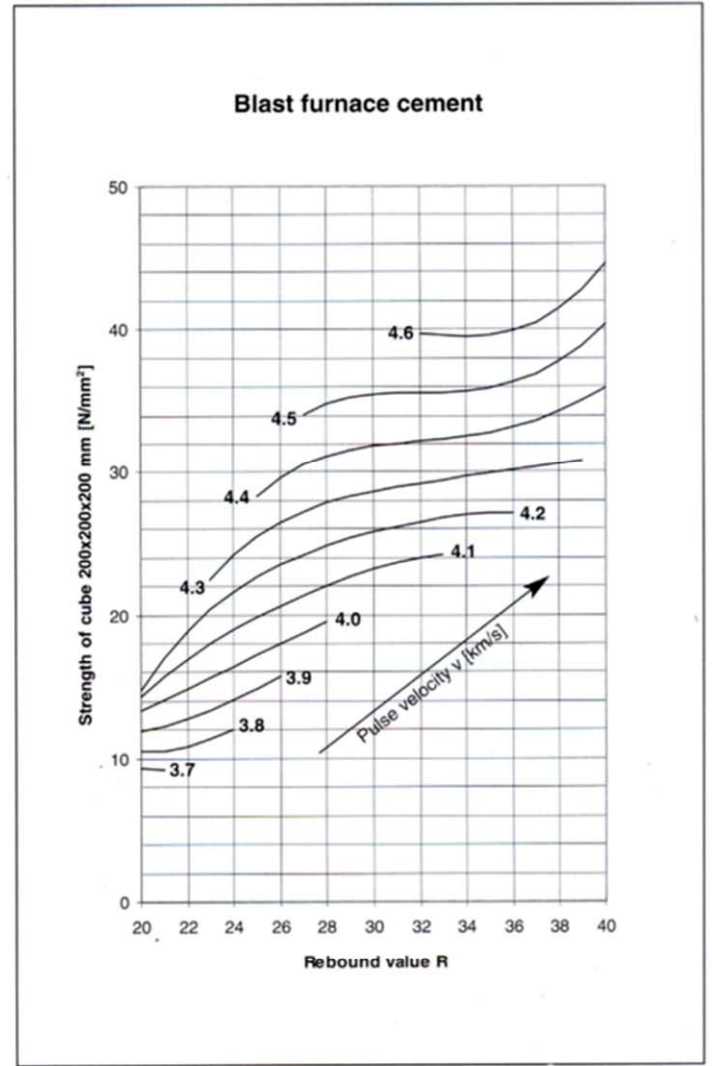


Diagram B Concrete strengths f_{ck}

3. Correction factor

The pulse velocity depends not only on the concrete quality but also further factors, such as temperature, humidity, arrangement of the rebars, etc. These influences are described in the standards (e.g. BS 1881 Part 203) and can be included here as a correction factor.

Input factor using the keys $\uparrow\downarrow \leftrightarrow$.

The factor set multiplies the measured time. This corrected time is displayed and is used for further calculations.

Example: At a temperature of -4°C and moist concrete, the pulse velocity increases by 7%. A correction factor of 0.93 should therefore be set.

4. Measurement No

The number is automatically incremented after each measurement.

5. Basic settings

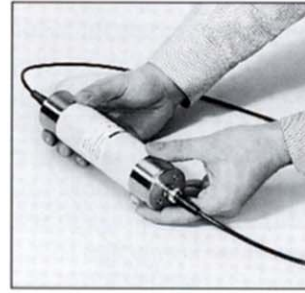
5.1 Choice of unit for length and strength

The keys $\uparrow\downarrow \leftrightarrow$ can be used to select the length unit m or ft and the strength unit N/mm^2 , MPa, psi or kg/cm^2 .

5.2 Calibration

The standard 54 kHz transducers are calibrated for the display unit. The calibration value is marked on the calibration rod and must have the value entered here. If other transducers are used (transducers with other frequencies or exponential transducers), these must be

calibrated as follows:



- Correction factor 1.0 set.
- Select Basic Setups
- Switch to calibration with $\uparrow\downarrow$ key and then press the «START» key.
- Connect transducers to display unit with BNC cable.

- Apply coupling paste thinly.
- Input calibration value from the calibration rod or check that the stored value corresponds to the value on the rod.
- Press the «START» key.
- Press transducers against calibration rod.
- After 5 seconds, a beep is heard and the calibration value is automatically stored.
- Continue to press the transducers against the calibration rod:
The unit now switches to the measurement image and forms a check measurement.

The calibration is thus complete.

Before the standard transducers are used again, they must be calibrated as described above.

For the use of other transducers (depending on size and cross-section of the object to be tested, on the concrete composition and on the method of measurement) refer to the standards and the literature.

6. Automatic storing

Selecting Automatic storing on or off determines the type of measuring process (see Section C, Parts 1.1 and 1.2).

7. Measuring limits

Depending on the type and quality of the concrete, the measuring range (distance between the transducers) is limited (for details refer to chapter C1.).

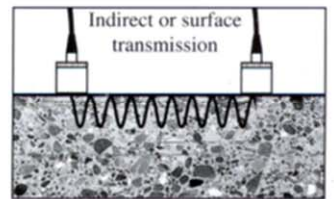
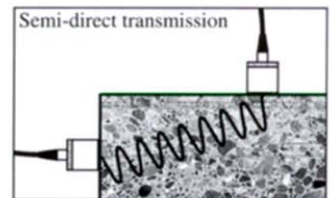
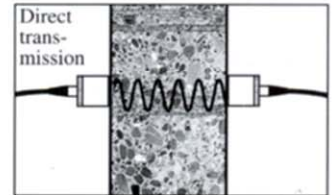
The minimum measuring distance depends on the minimum measuring time remaining of 15 micro seconds (refer to chapter Form supplied, Display unit). For concrete with wave speeds of 3'600 to 4'800 m/s this corresponds to a minimum distance of 54 mm to 72 mm.

The required minimum lateral distances according to table 2, chapter 7.5 of BS 1881, part 203 must also be taken into consideration when measuring with the TICO (e.g. with a measuring frequency of 54 kHz and a wave speed of 4'500 m/s, 83 mm are required).

C. Measurement process

1. Direct and semi-direct measurement

- Determine the measuring points.
- Measure the distance between the measurement points accurately to 1% of the length, max. cable length at direct measurement 1,5 m, distance at indirect measurement 0,1 to 0,5 m, but for semi-direct measurement 0,2 to 0,6 m.
- Input settings in the MENU and then press the «END» key.
- Apply coupling paste to contact surfaces of the transducers and to the points on the object to be measured (thin coat for fine concrete surface, thicker coat for rough surface).
- Press «START» key.
- Position transducers exactly on the measurement points and press down.



Methods for measuring the transmission time with transducers acting as transmitter and receiver, for calculating the pulse velocity.

1.1 Measurement with "Automatic storing" on

- During the measuring time, only t is displayed. As soon as the measured value is stable for 3 second, a beep is heard and the pulse velocity is displayed under v . If the R-value was input under rebound value in the MENU, the strength is displayed under σ_k .
- The values displayed can be stored by pressing the «STORE» key. If there is uncertainty about the measurement, press the «START» key instead of «STORE» and repeat the measurement.

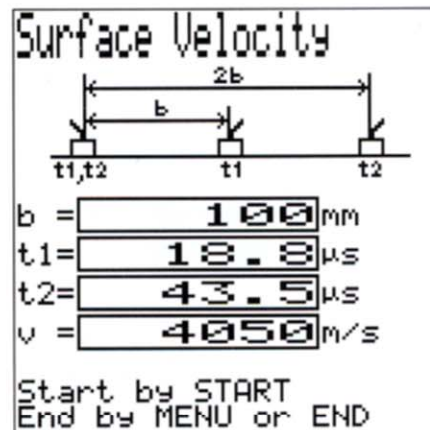
1.2 Measurement with "Automatic storing" off

During the measuring time, v and, if R was input, also σ_k are also displayed in addition to t . The values can be stored at any time, it being necessary to continue pressing down the transducers. The «STORE» key would therefore have to be pressed by a third hand.

2. Surface velocity

For indirect (surface) measurements, a multiple measurement according to the standards (BS 1881 Part 203, NBN B 15.229) is recommended. In the MENU, select "surface velocity" with the «START» key.

The following measurement image appears:



Measurement process

- Connect the transducers to the unit and apply coupling paste.
- Measure distances b and $2b$ on the test object and identify them (b may not be greater than 250 mm).
- Input distance b in the unit with the keys $\uparrow \downarrow \Rightarrow$.
- Press the «START» key: the distance is displayed under b in the measurement image and at the same time the sound pulses are emitted.
- Press transducers against the object and measure b . As soon as the measured value is stable for 3 seconds, a beep is heard and the transmission time is displayed at t_1 .
- By pressing the «STORE» key, the value is stored

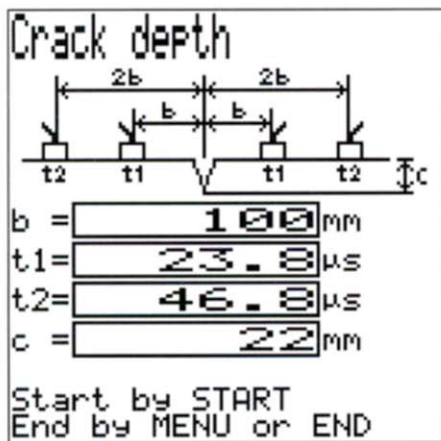
and the unit is switched to t2 for measurement.

- Press transducers over distance 2b. After a stable display for 3 seconds, a beep is heard, after which the «STORE» key can be pressed.
- The surface velocity is now displayed at v.

Important: In the event of uncertainties, press the «START» key instead of «STORE» and repeat the measurement.

3. Crack depths

The following measurement image appears:



Measurement process

- Connect transducers to the unit and apply coupling paste.

- Measure distances b and $2b$ on the test object and identify.
- Input distance b on the unit with keys $\uparrow \downarrow \Rightarrow$.
- Press the «START» key: the distance is displayed under b in the measurement image, at the same time the sound pulses are emitted.
- Press transducers on the object and carry out measurement b to b : as soon as the measurement value is stable for 3 seconds, a beep is heard and the transmission time is displayed as t_1 .
- By pressing the «STORE» key, the value is stored and the unit is switched to t_2 for the measurement.
- Press transducers to distance $2b$. After a stable display for 3 seconds, a beep is heard after which the «STORE» key is pressed.
- The crack depth is now displayed at c .

Important:

- The distance b may not be chosen greater than 125 mm.
- The transmission time t_2 must be less than twice t_1 , otherwise no crack depth calculation is performed.
- If there is uncertainty as to whether the measurement has been correctly performed, the «START» key should be pressed again instead of the «STORE» key and the measurement repeated.
- The crack depth can be measured only in cracks at right angles to the surface.

D. Data Output

Data format of the RS 232 C: 9600, n, 8, 1

When the memory is full, the oldest values are overwritten.

1. Data display

The measured values can be called up from the memory by means of the cursor keys $\uparrow\downarrow$ and can be shown on the display.

2. Data to PC

Under WINDOWS, the data are transmitted in EXCEL format to a PC with the aid of the terminal program.

	a	b				
TICO Ultrasonic Instrument SN0010.0039 1.10						
100000	50.4 us	0.22 m	4370 m/s	30.7 N/mm ²	1	34 P
100001	53.7 us	0.22 m	4100 m/s	26.0 N/mm ²	1	35 P
100002	51.9 us	0.22 m	4240 m/s	30.3 N/mm ²	1	38 P
100003	56.0 us	0.22 m	3930 m/s	21.8 N/mm ²	1	33 P
100004	52.2 us	0.22 m	4210 m/s	26.5 N/mm ²	1	34 P
100005	49.9 us	0.22 m	4410 m/s	34.0 N/mm ²	1	38 P
100006	50.9 us	0.22 m	4320 m/s	31.5 N/mm ²	1	37 P
100007	52.5 us	0.22 m	4190 m/s	26.0 N/mm ²	1	34 P
100008	54.7 us	0.22 m	1020 m/s	21.8 N/mm ²	1	32 P

a Number of display unit

b Software version

c Measurement number

d Transmission time

e Distance

f Pulse velocity

g Concrete strength

h Correction factor

i Rebound value

k Cement type

20

For data transmission to PC, also see INFO 2004 06 509-1 D/E/F.

E. Elasticity module

Dynamic and static elasticity modules can only be determined indirect by measuring the sound waves and conversion using table 4 in chapter 12 of BS 1881, part 203. They are only regarded as general indications for «normal» Portland cement.

F. Function test

A control measurement should be carried out from time to time with the calibration rod (refer to chapter B5.2).